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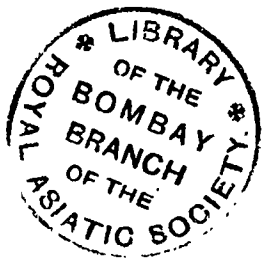
ON THE ORIGIN OF SPECIES BY MEANS OF ORGANIC AFFINITY.



ON THE ORIGIN OF SPECIES

BY MEANS OF

ORGANIC AFFINITY:

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BY

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"Nothing is advanced in this publication that is not perfectly in harmony with the Mosaic record of Creation."—*Preface.*

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TO

CHARLES PHILIPS CROKER, M.D., T.C.D., M.R.I.A.,

EX-PRESIDENT OF THE KING AND QUEEN'S COLLEGE OF PHYSICIANS IN IRELAND,
ETC., ETC., ETC.

THE FOLLOWING PAGES

Are Inscribed,

AS A VERY TRIFLING TOKEN OF PERSONAL ATTACHMENT, AND OF GRATITUDE
FOR NUMEROUS FAVOURS,

BY

THE AUTHOR.

LIBRARY
OF THE
BOMBAY
BRANCH
OF THE
ROYAL ASIATIC SOCIETY

PREFACE.

In a somewhat extended series of papers on "the Pathology of Inflammation and Fever," published by me in *The Dublin Medical Press*, during the years 1851, 1852, and 1853, and diffused through several volumes of that Journal, I *incidentally* introduced my views "*on the origin of species by means of organic affinity.*" I did so, however, in such manner as was least likely to obtain for them much notice. Views thus put forward, in connexion with a subject towards which they may appear to have had but little relation, and coming before readers who for the most part took extremely little interest in the question, I did not, or indeed could not, expect would attract much attention. Other pursuits have since prevented me from submitting those opinions to the public in a detached form.

The interest created by Mr. Darwin's recently published work on the same question, connected with the fact of that distinguished naturalist having reached a conclusion identical with one I had myself attempted to establish, has led me to believe that the present would be a favourable opportunity for me to reproduce my own views, and now for

the first time to submit those views to the judgment of the public in a distinct and separate form.

In doing so, I cannot refrain from expressing the great satisfaction I have felt on recognizing a coincidence between one of the ablest living naturalists and myself upon *one* important question—and I regret that it should be *only* upon one—in relation to this interesting inquiry. I refer to the fact that both Mr. Darwin and myself have been led—each by his own peculiar views—to believe that all organic creation has originated from a single primordial germ.

In directing attention to this coincidence, I desire that it should be most distinctly understood that nothing could be more remote from my intention, than to attempt in the slightest degree to detract from the originality of that distinguished author's able work. We had both reached the same result through a totally different channel. Mr. Darwin attained by *analogy* to what I had attempted to establish by *induction*; and it is of importance to science that naturalists should be aware that such is the case. For the fact of two independent enquirers, *utterly unconscious of each other's existence*, having reached, by *a totally different order of inquiry*, an *identical* and at the same time an *unlooked for result*—at least upon my part altogether unlooked for—such fact, I say, impresses that conclusion with such a stamp of probability as *almost*, in my mind, to withdraw it from the domain of *hypothesis*.

I shall here merely add, that nothing is advanced in this

publication that is not perfectly in harmony with the Mosaic record of creation. In relation to this subject, however, I would beg to refer the reader to my concluding observations at page 131.

H. FREKE.

Dublin, 28, Holles-street,
January, 1861.

ON THE ORIGIN OF SPECIES

BY MEANS OF

ORGANIC AFFINITY.

CHAPTER I.

EMBRYOLOGY,*

VIZ.: THE ANATOMIC CONSTITUTION, THE PHYSIOLOGICAL FUNCTION, AND THE MODE OF THE FORMATION OF EMBRYONIC GERMS UNIVERSALLY.

In order to avoid teasing the reader subsequently with perplexing repetitions, it may be desirable for me, in the first instance, to say a single word of explanation—somewhat in the form of definition—as a preliminary to the present inquiry. As I do so for the purpose simply of obviating ambiguity, I trust the reader will bear with it for but a moment.

By *matter* is understood the elementary components of the

* I would beg to observe that I have reluctantly been induced throughout these pages to employ the word "*embryo*" in a sense not perhaps strictly speaking correct; that is, attaching a meaning to the word not strictly in accordance with that in which it is most usually employed. What I desire to convey by the word "*embryo*" throughout these observations, is simply this—viz.: the *earliest* embryonic germ or ovule from which an organized being has originally sprung, as, for instance, the germ contained within the human Graaffian vessicle. My reason for thus departing from the more ordinary use of the term embryo, is that having done so in my former publications, from which I shall have extensively to quote, I could not conveniently avoid doing so now.

universe, whether considered individually or in combination. The material objects of this world have been divided into *inorganic* and *organic* creation, within the latter of which are comprised the objects of living creation, while living creation again is divided into the vegetable and the animal kingdoms.

Every developed living being, whether it be a vegetable or an animal, must obviously have undergone the process of *being developed*, before its development could have been *completed*, and every such living being has originated or emanated from an *embryonic germ*, which embryonic germ has been the cause of—or has *given rise to*—its development. Consequently every living being should be contemplated in relation to the following three conditions, namely, 1st, as an embryonic organism, or *before* the process of its development has commenced; 2nd, as a developing organism, or *while* the process of its development is *in the act* of taking place; and, 3rd, as a developed organism, or *when* the process of its development *has been accomplished*.

I shall direct attention to organisms, both vegetable and animal, in relation to each of these conditions—and, first, with regard to embryonic organisms. The questions in relation to embryonic germs which I shall more especially bring under consideration are the following three—namely, the nature of the anatomic *constitution;* the nature of the physiological *function;* and 3rdly, the *mode* of the *formation* of embryonic germs universally—that is, of *all* embryonic germs throughout both the vegetable and the animal world.

It is needless for me to introduce here an elaborate definition of the terms *organic* and *inorganic*. It will be sufficient for my present purpose to observe that within the former term is included the idea of a certain definite relative arrangement among a plurality of elements, distinct from that which would result from the *mere* action of their physical and chemi-

cal laws. While by the latter term or *inorganic* matter, is understood matter, the components of which are solely under the control of physical and chemical laws. Such rude expression of the meaning of those terms is adequate for the purpose I have at present in view.

When we see a seed cast into the unorganized earth converting that earth's *inorganic* components into an *organized* tree, the propriety of calling that seed an organiz*ing* agent, can, I conceive, scarcely be questioned.

Whatever other function or property (if any) that seed may be supposed to possess, to me it would appear obvious that it unquestionably possesses this, namely, the property of *conferring or imparting organization* to certain constituents of the earth, which had hitherto existed in the *inorganic* or *unorganized* state. I consequently, cannot conceive the possibility of any one questioning the propriety of my designating that seed an organizing agent.

If instead of the seed just referred to we were to cast into the same unorganized earth a portion, say of the *woody fibre* of the tree tha thas been developed by that seed, we do *not* see a similar result to take place. We do not see that woody fibre (like the seed) converting the inorganic components of the earth into an organized tree. In a word, we do not see that woody fibre conferring or imparting organization. Consequently, be the properties or functions of that woody fibre what they may, we unhesitatingly state that it is *not*, like the seed, an organiz*ing* agent.

For the performance, then, of some *other* physiological function distinct from that of *conferring* organization, that woody fibre must obviously have been destined by nature.

For it must be manifest to every one that all organic matter has been constructed or organized for the express purpose of giving development to, or performing, *some* distinct and determinate physiological function, be the nature of that function what it may.

All organized structures which (like the woody fibre just referred to) are *not* organizing agents, but are designed to perform some *other* physiological function, I shall, for reasons which will presently become apparent, designate organized residual products.

To one or other of the two catagories just mentioned, namely, either to that of organizing agents, like the seed, or that of organized structures which like the woody fibre, are possessed of some other physiological property distinct from that of conferring organization—to one or other, I say, of these two categories may every individual organic structure found throughout organic creation be referred.

Such being the case, *all* organic matter universally, may, for our present purpose, be advantageously divided into the following two *classes* of organic structure, namely, 1st, into organizing agents; that is, organic entities, whose function, like that of the seed referred to, is to confer or impart organization; and 2nd, organized residual products—that is, organized structures, which, like the woody fibre referred to, have not been endowed with this function of conferring or imparting organization, and which consequently must have been designed to discharge some other physiological function. Of such organized residual products we have an example, as I have observed in woody fibre in the vegetable, as also in muscular fibre, nervous tissue, and cerebral matter, &c., in man. In all *living* beings, namely, both in vegetables and animals, these two classes of organic structure exist *in conjunction*. I shall say a few words upon each of these two classes of organic structure.

I shall first direct a moment's attention to the latter of the two; namely, to the organized structures—such as woody fibre, muscular fibre, nervous tissue, &c.—which are not organizing agents, that is, which have *not* been constructed for the purpose of conferring or imparting organization.

If we examine man—the climax of organic creation—in relation to his *anatomic* construction, we find but a comparatively limited number of distinct species of organized structure entering into his anatomic constitution. Bone, muscle, nerve, and a few others are for the most part the tissues of which man is anatomically composed. Take any other species of animal, or any number of other species, say the lion, the horse, the dog, and the mouse, &c., examine each of these distinct species separately, in relation to its anatomic constitution, and what do we find? We find this—namely, a *repetition* in each, of the *very same* species of organized tissues, only differing as to their *number* and their *relative arrangement.* Mark this well—we find a difference, I say, in the *number* and the *relative arrangement* of the *same* species of organized tissue, as constituting the most conspicuous distinction between the different species of animal referred to.

If such be the fact—and there are, perhaps, few who will be at the trouble of reflecting, who will question or doubt it—it at once becomes obvious that the distinction between the different species to which I have referred, cannot be supposed to depend so much upon any physiological distinction in the organic tissues of which the individuals of those several species are anatomically constituted, as upon a difference in the number and *relative arrangement* of tissues common alike to one and to all of those different species. I shall illustrate my meaning. What, for instance, is it which constitutes the specific distinction between the horse and the dog? Obviously, it does not so much depend upon any specific distinction between the component organized tissues of which they are respectively anatomically constituted, such as bone, muscle, nerve, &c.—inasmuch as those structures are, as I have observed, pretty much the same for both species—as upon a difference in the number and relative arrangement of those bones, nerves, muscles, &c. ;

that is, a difference in the number and relative arrangement in the same species of organized tissue common to the two different species of animal just mentioned. The same is obviously equally true of the other species of animal referred to. The horse, the dog, the lion, and the mouse, &c.—although distinct species of organized beings—are for the most part composed anatomically of one and the same species of organized tissue. The specific distinction in each species would then appear to me to be manifestly dependent upon some distinction in the number and relative arrangement of those tissues.

In a word—*identity*, in the number and relative arrangement of the different species of organized tissue referred to (such as bone, muscle, nerve, &c.) found to exist in different individual animals, would, in my mind, constitute *identity* of *species* in those individuals—I should consequently be led to look for some *diversity* in that number and relative arrangement as existing in *different species*, and such diversity upon inquiry is found actually to exist.

It is obvious that the principle of this observation is equally applicable to the entire range of *animal* creation. A little reflection will show that with a very slight modification of the language employed, the very same observations may, with even still greater force, be applied to the objects of the vegetable kingdom. In this division of organic creation the different species of organized tissue, such as woody fibre, &c., though somewhat different from those found in the animal kingdom, appear to be even more limited in number.

What then do we collect from the contemplation of the foregoing facts?

We collect these two, as I regard them, not unimportant reflections in relation to the question before us—namely, 1st, that the number of distinct species of organized structure—such as woody fibre, &c. in the vegetable, and muscular fibre,

&c. in man—that the number, I say, of distinct species of organized tissue found to exist throughout organic creation generally, is far from being very considerable; and 2nd, that the distinctions between the various species of organized beings existing throughout organic creation—be their cause what it may—depend less upon any distinction in the species of *the component organic constituents* of the individuals comprised in the different species, than upon a difference in the *number and relative arrangement* of those component organic constituents. Thus, then, it would appear to me that the question as to the origin of species generally throughout organic creation resolves itself into the following inquiry, viz., What has been the cause of or *origin* of the difference in the *number* and the *relative arrangement* of the different species of organized tissue, comprised in the anatomic constitution of the individuals of the different species? How has this observed difference in the number and relative arrangement of those tissues been brought about? What has been *its* origin? For be *its* origin what it may the *same* would appear to me to have been "THE ORIGIN OF SPECIES."

What then has been the origin of this distinction?

To me it would appear that the origin of the distinction referred to must be dependent upon one or both of the two following causes—namely, either first, upon some distinction in the number and relative arrangement of the anatomic components (be they what they may) of the *germs* or *embryos* respectively of the several different species of animal referred to; or 2nd, upon some distinction in the materials upon which those embryos or germs respectively discharge their physiological function; or, finally—as I shall presently attempt to prove, *is* the true origin of the distinction in species referred to—some distinction *both* in the *germs themselves* and also in the *materials* specially provided by nature, for the purpose of enabling those germs to discharge their physiological function.

For, observe in relation to the several different species of animal referred to, the following four facts, viz. :—

1st. They all *agree* with each other in being composed anatomically of *the same species* of organized tissues.

2nd. They all *agree* with each other, too, in being derived in *the same manner* (be that what it may) from the development of an embryo or germ.

3rd. They all further *agree* with each other in this, namely—that that embryo or germ for each requires *something* (be it what it may) specially adapted for enabling that germ to discharge its physiological function in a normal and natural manner; and,

4th. They all *differ* from each other in this, namely—that the *number* and the *relative arrangement* of their component anatomic constituents *differ* for each distinct species.

From these four facts, which to me would appear to be unquestionable truths, it would seem to me that we are justified in unhesitatingly deducing the following conclusion, viz.:

That the *origin* of the difference in species of the several animals referred to must be this, namely, *some distinction* either in the anatomic constitution of the respective germs themselves, or in the materials provided by nature upon which those germs can normally discharge their physiological function, or—as shall be my effort to make apparent is the fact—some specific distinction in *both* the embryo and the materials so provided by nature.

If such be the case we are called upon to inquire into the following two questions; namely, 1st, into the nature of the anatomic constitution and physiological function of germs or embryos in general; and 2nd, into the nature and function of the constituents specially provided by nature, so as to enable those embryos or germs to discharge their physiological function in a normal or natural manner.

This brings us to the first question we have proposed to

ourselves for consideration, namely, the anatomic constitution and physiological function of embryonic germs generally.

What, then, is the nature of the anatomic constitution and of the physiological function of embryonic germs universally? I say universally, for if we can attain to the recognition of the true constitution and function of any solitary embryo or germ, however humble it may be, I have no hesitation in stating it to be my opinion that we shall therein have attained to a knowledge of the *nature* of the constitution and the function of all the embryos or germs in existence, not even excluding the embryonic germ of man. For how rarely do we find nature employing a variety of means to bring about *one and the same* end ; nor do I think we shall find she has done so in this case. Let us then direct our inquiries to the nature of the anatomic constitution and of the physiological function of reproductive germs in general.

How should this be done? The most rational way, as it appears to me, of searching for a knowledge of these facts is this. Seek for one of the simplest or least complex germs to be found in organic creation ; ascertain the nature of *its* constitution, and observe the nature of *its* function, and I feel assured we shall therein have disclosed to us the nature of the constitution and the function of every embryonic germ existing throughout the entire of organic creation.

Let us then seek this information in the spores or reproductive germs of what botanists term cryptogamic, or agamic plants. Take some individual of the family of the Fungi or of Lichens, for example, and study the constitution and function of *its* germ. And what do we find? We find simply this. We find a single grain, as it were, of dust, which, when shed upon the *inorganic* earth, we see developing or generating from that earth a fungus or lichin identical with that which the germ has just left.

Here, then, we have clearly and distinctly, as I conceive,

disclosed to us two (as I regard them) important physiological facts, namely; firstly, the nature of the *function* of the embryo or germ of that fungus or lichin (and consequently, as I conceive, the *nature* of the function of embryos or germs *universally*) and, secondly—and I would solicit attention to this statement—and, I say, secondly, the nature of the materials specially provided by nature for calling, or, if I may so term it, *stimulating that* embryo or germ to the discharge of its physiological function.

The function of the germ, as it appears to me, has been obviously this, namely, *to confer or impart* organization; in a word, that germ is manifestly, as I conceive, an organizing agent. Such, I say, would appear to me to be manifestly the function of that simple species of embryonic germ; and such, I shall presently attempt to show, is in like manner the function of every species of reproductive germ throughout the entire of organic creation, from the simplest to the most complex, from that of the lichen to that of man. The function of each and of all is the same; namely, to confer or impart organization—in a word, they are all alike—organizing agents. This I shall presently attempt to make clear.

Having, in my publication of 1848, directed attention to the physical constitution of inorganic creation, and having pointed to the relation in which the forces—such as gravity, caloric, electricity, &c. which control the operative action of *its* ponderable elements and their compounds—having pointed pointed out, I say, the relation in which *those* forces stand towards *inorganic* creation's material components, I thus, by way of analogy, observe:—

"If, having made ourselves familiar with inanimate creation, with its atoms, its compounds, its worlds and their systems,—if, having learned of its attributes and laws, it were announced to us that some researcher in science, having recognized a new species of creation, having seen matter

under aspects hitherto unobserved, had attained to the discovery of a new class of compounds—of compounds possessed of symmetrical form—should we not, making analogy the guide of our reason, be led to attribute this new class of compounds to the operation of their attributes, general and specific, in an hitherto unrecognized or NEW CLASS OF ATOMS.

"Such experimental researcher is Mankind at large, experience presents all with this new class of *compounds* in the varied departments of an organized world."*

As we proceed, I shall endeavour to make it appear that such new class of *atoms* does in reality exist in the form of *physiologically* indivisible organiz*ing* agents, I shall further endeavour to show that every *embryonic germ* in existence is composed of one or more such atomic, or physiologically indivisible organiz*ing* agent; and that all such embryonic germs (or organiz*ing* atoms) on having completed the discharge of their physiological function have,—*as that function*—develope*d* the various new class of *compounds* referred to, namely—in other words—the various vegetables and animals to be met with throughout organic creation.

That such statements are facts, I say, I shall presently endeavour to prove; but perhaps, before doing so, I ought here to explain what I desire to convey by what I have just now termed, "the materials specially provided by nature for stimulating that germ to the discharge of its physiological function." My meaning in that statement may thus be expressed:—

"We called attention, when observing on the general forces which give motion to inanimate matter, to the necessity we conceived there to exist for the operation of what we called that matter's reciprocal or stimulus, before the action of such forces could be manifested. Our object in so doing was to point to a similar necessity which we regard as existing, for

* Freke on Organization, (1848) p. 23.

the operation of an analogous reciprocal or stimulus, before the action of the analogous general force, the organizing influence, can manifest its active operation. We would now direct attention for a moment to what we would call the law of reciprocity, or, more correctly, (if we be allowed such expression), the law of specific stimulation. Gravity is, we conceive, not more universally a force operating through matter, than is this law of reciprocity or stimulation—a law universally applicable to operative forces. Let us be understood; what we desire to convey is, that experience presents us with no example of a force operating through matter as a cause of manifest results, that has not been made of necessity, and essentially dependent for that manifestation on the operation of something distinct from the matter through which such manifestation takes place. Such we have seen, in the inanimate world, to be the case with gravity, caloric, and electricity, and such is obviously equally true of inanimate matter's specific laws, or of the forces called chemical.

"A little reflection will show that this law extends with a like universality over the entire of the organized world. We see the seed, which for centuries has lain inactive and indolent, spring instantaneously into action when that something is present. We see the function of the contents of the animal ovum for ever undischarged, unless by its stimulus called into action. But, not to multiply examples, how perpetually in our own persons are we told of this law? How completely has our nervous system been made subservient thereto. We find our sentient nerves, whether those of special or of ordinary sense, have each its appropriate agency for calling its function into action. Does the organ of vision discharge its function in the absence of light? Is that of hearing in activity when no vibrations exist? Do not the olfactory and gustatory nerves require something specific in matter's construction, without which smell and

taste were for ever unknown? And does not the ordinary sense of touch require contact as its excitant? Nor is this law confined to the sentient portion of our nervous system, but is in equal force with respect to our motor apparatus, at least that portion of it known as the voluntary nerves. Volition, and volition only, can in a normal condition of the organism call into active operation the function of the voluntary nerves. Volition is then obviously the normal excitant or specific stimulus of the voluntary nerves. All such excitants will illustrate what we now mean to convey, when we employ the term reciprocal or specific stimulus, namely, that, be it of what nature it may, which for each is capable of calling into operation its functional action.

"If, then, this law of reciprocity or of specific stimulation be universally applicable to all operative forces, we should expect to find each organism constructed for conferring organization; that is, each link in the chain of our organizing atoms must be provided with some distinct specific stimulus, which is capable of calling into operation its functional action. In other words, before any organizing atom can confer its organizing agency upon matter, that atom must be exposed to the influence of its own specific stimulus, so that for each link in the great chain of progressively advancing organizing atoms, we must look for an appropriate stimulus; constituting, collectively, a corresponding chain of progressively advancing excitants or specific stimulants. That such is the case it shall be our endeavour to show; and, with this view, we would now call attention to the contemplation of life in its simplest process; that is, as it is manifested by the humblest of vegetations, or by the first or simplest link in our organizing chain; and, before doing so, we would, in the first place, premise that, as in the inorganic or inanimate world, having acquired a knowledge of the principles which regulate the operation of the general

forces, gravity and caloric, as they control the physical action of an individual particle of any species of matter, we may predicate the same as their principles of operation on all inanimate matter universally; so, in the organic world, or world of animation, if we can attain to a knowledge of the principles which regulate the operation of the great general force, the organizing influence, as it controls the physiological action of an individual organizing atom, we may predicate the same as its principle of operation on all the organizing atoms throughout organic creation.

"Let us, then, retaining this reflection in the memory, contemplate life in its simplest process, or as it is manifested by the first link in our organizing chain, that therefrom we may collect *the general laws* which regulate the manifestation of *all* earthly life. A microscopic granule formed of carbon, oxygen, hydrogen, azote, and potassium, (or the like) combined in definite proportions, and so relatively arranged as to constitute the condition called organized, is all we can be said to know as to the material composition of that atom. The arrangement in the relative positions of those constituents is, as we have seen, essentially distinct from that which their own specific attributes as inanimate matter would bring about. On the constituents of that atom are operating two distinct and opposing forces, each, as it were, energizing to exercise its sway; the organizing agency (if I might so term it) retaining them in the condition of organization; their specific attributes, or, as it is called, chemical affinity, struggling to render them inorganic. So long as these two antagonistic forces balance each other's action into a condition of equilibrium, there will obviously be no manifestation of the action of either; and this organizing atom can exhibit no active properties in consequence thereof, which would distinguish it from ordinary inanimate matter."*

* Freke on Organization (1848) p. 35.

Again I observe at page 40:—

"Here, then, we have disclosed to us what it is which constitutes the specific stimulus of the first or simplest link in the organizing chain, namely, the unorganized or mineral matter upon which it is about to confer organization. Here, too, we have suggested to us what it is which must constitute the specific stimulus of each succeeding link of that chain; namely, that for each upon which each was destined to confer organization—that for each upon which each has, from its construction, been adapted to exercise its function of elevating it one progressive step in the great scale of organization. Thus, then, as we have been led to believe in the necessary existence of a chain of progressively advancing organizing agents or atoms, whose function is *to confer* organization; so, too, we believe in an equal necessity before that function can be fulfilled, for the existence of a corresponding chain of progressively advancing organized structures, whose function is *to receive* organization, and which were designed and adapted for calling into operation the function of the organizing atoms. Between these two chains, at corresponding positions respectively in each, such natural reciprocity we conceive to exist, that when brought (conjointly with the necessary contingency to the atom of increased chemical action) within the sphere of each other's reciprocal operation, an interchange of action, as it were, takes place between them, and each discharges its functions respectively—the atom of imparting, and the reciprocal or stimulus of receiving, the organizing influence. The first link in the chain of atoms is the simplest of vegetations. The first link in the chain of stimulants is mineral matter. The last link in the chain of atoms may be the most highly organized organizing atom existing within the complex organism, man. The last link in the chain of stimulants is some highly elaborated organized product, which may arouse that atom to the discharge of its functional operation—some highly organized

structure upon which the last atom can confer an increased organization. And as, when directing attention to the stimulus which was capable of calling into operative action the caloric which had been latent in matter, we solicited permission to call such stimulus *that which was below such matter in the scale of calorification;* so we now see that the stimulus which is capable of calling into operative action the organizing influence which had been latent in the organizing atom, is *that which is below such atom in the scale of organization.* The first link in the organizing chain is but removed from inanimate matter—the stimulus of that link is *inanimate.*"*

Again I observe in the *Dublin Medical Press,* 1851, as follows:—"I should wish to direct my reader's attention for a moment to a general physiological law, upon the universality of which some of them may in all probability have never reflected—a law which not only is *absolutely* universal, but the *absolute necessity* for the institution of which is apparent from the nature of physiological phenomena. That law I have termed the law of *specific stimulation.* I shall explain. It has been so arranged by nature, and that too upon principles which admit of a most simple and intelligible explanation—that no organized structure, whatever be its nature, can, *in a normal manner,* discharge a specific physiological function, whatever that function may be, without the operation of some specific stimulus; without, in other words, the operation of something provided specially by nature for calling that organized structure to the discharge of its specific physiological function, it matters not what the nature of that function may be. Had this law not been instituted—had such provision not been made, vital actions would be discharged independently of control, and all organized beings must soon cease to exist. We should see in the dark; we should hear while

* Freke on Organization (1848) p. 40.

there existed no cause to produce sound; we should walk without will; and we should live without food: all life would for a time be a chaos of confusion, and the duration of that time would be short. I have stated that the physiological principle upon which this law is dependent is both intelligible and simple; but, though simple, its exposition would occupy considerable space. I shall consequently content myself for the present by requesting my readers to run over in imagination the various organized structures with whose physiological function they are acquainted, and they will be able to recognize, if not the *universality*, at least the very general existence of this law."

Some of the expressions employed in these quotations may possibly, in the absence of the context, appear a little obscure; but, should such be the case, I trust as we proceed they will become intelligible.

Having then said thus much upon the *functions*, respectively, of germs and their specific stimuli, before proceeding to inquire more minutely into those functions, the present appears to be the appropriate place to make some observations upon the anatomic constitution of embryonic germs, or, as I have termed them, organizing agents.

I shall, consequently, now proceed to the consideration of that question, and shall point out why it is I have ventured to propose the term organizing atom as a fit and appropriate expression for simple organizing agents. Upon this subject I observe as follows:—

"It is a fact which, since the invaluable researches of Sehliden and Schwann, is well known to physiologists, that organized structures have their origin in some way from what are termed 'nucleated cells,'—that is, from a species of membranous envelope, containing in its interior one or more microscopic granules termed nuclei. To these nuclei have been given the name 'cytoblasts,' or 'cell-germs.'

The real nature of these so-called 'cytoblasts' or 'cell-germs' appearing to me to be still involved in obscurity, I some time ago (1848) proposed to myself for investigation the following inquiries—namely, 1st. The nature of the function of each individual so-called 'cytoblast' or 'cell-germ,' as also the requisites essential to the discharge of that function 2nd. The nature of the relation which subsists between these so-called 'cytoblasts' or 'cell-germs' and their *cell*—that is, in other words, the manner in which a so-called 'cytoblast' or 'cell-germ' *forms or generates a cell.* And 3rdly. The nature of the relation in which these so-called 'cytoblasts' or 'cell-germs' stand. 1st. With regard to inorganic or mineral matter. 2nd. With regard to each other. And 3rd. With regard to those other organic structures (distinct from these so-called 'cytoblasts' or cell-germs') which are found in the constitution of organized beings; such, for instance, as woody fibre, muscular fibre, nervous tissue, glandular structure, &c., &c. In relation to these inquiries, I attempted to establish the following propositions—namely, 1st. That the true and appropriate appellation of the ultimate organizing molecule, or of these so-called 'cytoblasts' or 'cell-germs,' is, '*Organizing Atom.*' 2nd. That the manner in which these so-called 'cytoblasts' or 'cell-germs' generate a cell is closely analogous to that in which a body radiating caloric may become surrounded by (as it were) an envelope of the matter to which it *imparts* its caloric. In a manner, for example, closely analogous to that in which the *water*, contained in a vessel which has been placed in the centre of a mass of ice, may be converted into *ice*, while in becoming so converted it imparts its caloric to the surrounding ice, converting it into water. As a final result in such case, we have a nucleus of *ice* surrounded by an envelope of *water*. 3rd. That these so-called 'cytoblasts' or 'cell-germs' so exist in nature as to constitute an unbroken chain of distinct organisms, gradually ascending in the scale

of organization from the humblest 'cell-germ' in the vegetable kingdom to the most elevated in the composition of man; and that the several links of this chain are, as it were, united or cemented together by one of the products of the function of each. And 4th. That the specific function of each link in that ascending chain of organisms—that is, the special function of each individual so-called 'cytoblast' or 'cell-germ' is to generate or create *a specific description of organized matter* which is essential, and which alone is competent, to call into *normal* operation the specific function of the link or 'cell-germ' next above it in the ascending chain of organisms or 'cell-germs;' between which specific description of organized matter and that 'cell-germ' which it is capable of calling into action, nature has placed a strong force of affinity or attraction analogous to that in the inanimate world which subsists between potassium and oxygen; and that thus through the agency of this specific product of each of the several links in the ascending chain, all the various links in the great organizing chain are united, or as it were cemented together.

"As these four deductions may require a moment's further explanation, I shall as briefly and as rapidly as is consistent with perspicuity, make a few observations upon each. First, then, as to wherefore I have proposed the adoption of the terms 'organizing atom,' and why I consider such appellation of importance. Upon what grounds I am of opinion that such designation of the ultimate organizing molecule is to be preferred to the term 'cytoblast' or 'cell-germ.'

"It must be obvious to every one that in a science like physiology the nomenclature cannot be regarded as a consideration of inconsiderable moment, inasmuch as thereby may be conveyed, perhaps in a term, the most correct or the most erroneous impressions. How should this nomenclature be regulated? How or upon what principles, should the nomenclature

in *every* science be constructed? To me it appears that the most appropriate and philosophic appellation that can by possibility be applied to *any* entity (be its nature what it may, or to whatsoever science it appertain) must of necessity be that which, without involving in it any hypothesis or theory, makes the nearest approach towards the expression of the *constitution* and the *specific function* of that entity. Let us then inquire if we can learn anything as regards—first, the constitution, and secondly, the specific function *of the ultimate organizing molecule.* First, then, as to the *constitution* of that molecule. It is well known to every one familiar with physical science that several phenomena in the inorganic or mineral world (such as the laws of chemical combination, crystallization, &c.) have led to the very strong presumption that all inanimate matter is composed of ultimate indivisible molecules, which molecules, from their supposed physical indivisibility, have received the very appropriate appellation, *atoms.* Notwithstanding, however, the strong presumptive evidence in support of such opinion, the infinite physical indivisibility of inanimate matter can scarcely be said to have been actually demonstrated, and the atomic constitution of *mineral* matter must still be regarded as hypothesis or theory. Does it follow from thence that such must be also the case with regard to *living or animate matter?* Does it result as a necessary consequence of our uncertainty as to the absolute *physical* constitution of *inanimate* matter that the infinite *physiological* indivisibility of organized beings must also be a matter of doubt or hypothesis? To my mind no such consequence results. I have no hesitation in stating that, to my mind, it appears to admit of the clearest demonstration that the infinite *physiological* divisibility of organized beings is utterly and absolutely impossible, and that consequently the *atomic constitution* of *living* creation is as much matter of demonstration as is any recognized fact in the science of phy-

siology. Let my readers distinctly understand that there is a marked and important distinction between physical or chemical and *physiological* division. It is needless to point out what constitutes physical or chemical division. What do I understand by the terms *physiological* divisibility? What I understand by physiological divisibility is this—namely, such a division of any physiological entity as does not destroy or affect the physiological properties essentially or specifically appertaining to that entity. I shall illustrate. A fasciculus of muscular fibres, for example, may be physically and at the same time physiologically divided into its several component muscular fibres, each of which may retain undestroyed and unaltered the properties which essentially and specifically belong to muscular fibre. Hence in this case such muscular fasciculus may, with the strictest propriety of language, be said to have been *physiologically* as well as physically divided. But if, instead of dividing that fasciculus into its several fibres, such fasciculus be triturated to a fine pulp in a mortar, its division is still physical, but it is no longer physiological, for the result no longer retains the physiological properties (unaffected or unaltered) which essentially and specifically belong to muscular fibre. Or if that fasciculus of muscular fibres be reduced to its elementary components, the division is chemical, but not physiological, for the physiological properties of muscle have been altogether destroyed. To me it appears that in every organism there must of necessity be a point beyond which physical division cannot possibly be carried without of necessity destroying the physiological condition which is essential to constitute what we understand by an organism."

Before introducing any further quotations, I shall here say a few words in explanation of the foregoing remarks, some of which, for the reason already referred to, may be somewhat

* Freke in *The Dublin Medical Press*, 27th August, 1851.

obscure; and I do so the more particularly, as I am most solicitous of being distinctly understood on this question.

Every organizing agent—such as the embryonic germ of a vegetable or an animal—must (as it appears to me) be in relation to its anatomic constitution, either a *simple* or a *compound* organism—a simple or a compound organizing agent. By a simple organizing agent I understand a *single individual entity*, not composed of *any* physiological plurality whatever. Such individual entity, it appears to me, from the phenomena I see taking place around me, must of necessity have existence. Such *may*, as I conceive, be the sole constitution of the embryonic germ of the humblest species of vegetable being; and such *is*, as I believe, the sole constitution of the embryonic germs or organizing agents which respectively give development to woody fibre, &c. in vegetables; and to muscular fibre, nervous tissue, cerebral matter, &c. in man.

By a compound organizing agent I understand an integral composed anatomically of a plurality of simple organizing agents. This combination of simple organizing agents constitutes a compound or aggregate integral, which, being itself an organizing agent, is consequently with propriety designated a compound organizing agent. Such, I shall presently attempt to show, is the anatomic constitution of the embryonic germs of the loftier vegetations, of animals, and of man—namely, that all such compound organizing agents, as the embryonic germs referred to, are composed of a plurality of different species of simple organizing agents; namely, those agents which give development respectively to the different species of organized tissue, found in the fully developed vegetable or animal.

Now, if an organizing agent be simple, that is, a single individual entity, and not composed of any physiological plurality whatever, then its *physiological* division would appear to me to be an impossibility, inasmuch as, not being a physiological compound, it cannot possibly be physiologically

divided; consequently its division, if it take place, must be either mechanical or chemical. Now, either of such divisions —namely, mechanical or chemical—must, as it appears to me, except under peculiar circumstances to be hereafter referred to —either, I say, of such division must, as I conceive, destroy that integrity which was essential to constitute that simple organizing agent a physiological integral or unity.

For if it be supposed that the mechanical or chemical division of that simple organism *does not* destroy its integrity as a simple independent physiological integral, then, I confess, I am unable to recognise what possible distinction there can be between an organizing agent and mineral matter; nor can I understand, upon this supposition, what is to prevent mineral matter from, at any moment, spontaneously becoming man.

Consequently, to me, I say, it would appear that either a mechanical or chemical division of that *simple* organizing agent must of necessity destroy its existence as a physiological integral, and consequently I designate that simple organizing agent an organizing atom; that is, an entity which is *physiologically atomic.*

A *compound* organizing agent, such as the human embryonic germ, of course admits of physiological division in the same manner as the fasciculus of muscular fibres referred to. But it can only be so far physiologically divided, till it has been decompounded or resolved into its several component simple organizing agents. Any division beyond this cannot be physiological.

Finally, I shall for the present merely add upon this topic, that if it be admitted that an *ultimate* fibre, either of wood or of muscle, does not admit of being *physiologically* divided (and to me it would appear that such fact is unquestionable) then (as it occurs to me) the same may be asserted with all the force of an *a fortiori* of an ultimate organizing agent, namely, an organic entity which has to maintain an independ-

ent vitality. With regard then to our first inquiry, in relation to the ultimate organizing molecule, namely—as to its anatomic *constitution*—I conclude that such molecule is *atomic*. The second inquiry, namely—as to the *specific function* of that molecule, we have already investigated and have found that such function is—to *organize*. Here, then, we have *constitution* and *function* (the elements, as I conceive, of the *most perfect* nomenclature) combining to suggest *Organizing Atom* as the most appropriate appellation for that molecule. I consequently submit, that to me it would appear, that *organizing atoms* should not (like inorganic or mineral atoms) be regarded as objects of hypothesis.

I shall here add no more on this subject, but I shall presently offer another argument in support of the atomic constitution of embryonic germs.

I shall now make a few observations on my second deduction, which is as follows—namely, that the manner in which organizing atoms develope or generate a cell is closely analogous to that in which a body radiating what is termed caloric or heat, may become surrounded by the matter to which it has, *as it were*, imparted that caloric or heat.

In entering upon the consideration of this subject, I wish it to be distinctly understood that I express no opinion whatever upon any theory which has been advanced in explanation of the phenomena caused by the agency called caloric or heat. I am solely desirous at present of pointing to a very striking analogy which to me it appears may be observed to exist between the functional action of organizing agents upon the materials to which they are imparting organization, and the action of ponderable matter, in its connexion with the agency or principle called heat, when imparting that heat to other ponderable constituents. Upon this subject I express myself thus:—

"The agency perhaps best known to all as a general cause

of motion in matter, as well artificial as natural, is that called caloric. Whether caloric be a material agent, whose particles are self-repellant, while they are attractive of those of ponderable matter, or its phenomena be more satisfactorily explicable on some different hypothesis, it concerns us not now to inquire. Against the correctness, however, of the following statements no question, we apprehend, will be raised, namely: 1st. That an agency (or its effects) which may be called caloric, or heat, is being perpetually transmitted in a radiating form from the centre of our solar system to earth and the other planets placed within the sphere of our sun's operation. 2nd. That the caloric thus transmitted can so combine itself with inanimate constituents, as to become latent, or, as it were, dormant or deprived of activity—that is, can so combine itself as to be unproductive of further apparent results than the construction of a modification in the arrangement of the constituents with which it so combines; while, by the destruction from any cause of this modified arrangement, the latency of the caloric may be at the same time destroyed, and then its influence as an active agent may at once become manifestly apparent. 3rdly. That the caloric, thus emancipated from association with inanimate matter, again radiates centrifugally in every direction, and may again exercise its influence upon such constituents as are placed within the sphere of its operation. And, 4thly. That the caloric thus radiated, if the constituents placed within the sphere of its operation be similar (but unmodified in arrangement) to those from which it was emancipated, will constitute in them the same modification in arrangement which previously existed in those it has left; and, having done so, will itself therein again become latent, the constituents with which it had previously been united being again reduced to the unmodified form; while it is during, and alone during, the transit of the caloric from one set of constituents to the other, that activity or motion is apparent in either.

"In the congelation of water by the melting of ice, we have presented to us a familiar example of each of these facts. We there see the caloric transmitted from the sun to the inanimate union of oxygen with hydrogen, so combine itself therewith as to become latent or unproductive of further apparent results than the construction of that modified arrangement of these constituents known to us by the name, water. This water, on being exposed to the influence of ice, we see yielding thereto its own latent caloric, thereby converting that ice into water, while itself becomes ice. *During* this process we see molecular motion in both water and ice, while at its close we find all has again become still; and had the water been originally placed in the centre of a surrounding mass of ice, we should have, as the final result, *a solid nucleus enclosed within an envelope of fluid.*"*

I shall now quote from the *Dublin Medical Press* for 3rd September, 1851, where I have entered more fully into this question, as follows:—"Place in a bowl a mixture of snow and common salt. In the centre of this *solid* mixture place a glass of *fluid* cream, and in a short time we shall have a *solid nucleus of cream* surrounded by an *envelope of fluid.* What is the change which here has taken place? It is this: an interchange in their respective conditions has taken place between the nucleus originally *fluid* and its *solid* envelope, the *former having assumed the condition which the latter originally held, while in doing so it has conferred upon the latter its own original condition.* And what is the cause of this interchange of condition? It is, as my readers are intimately aware, that the principle called caloric (be that principle what it may), which, before the experiment, retained the particles of cream in the fluid condition, was (when exposed to the influence of a solid body which had

* Freke on Organization (1848) p. 5.

a strong affinity for that principle) imparted by the fluid cream to the surrounding solid mass; the consequence of which was that the fluid, having parted with the *cause* of its fluidity, became solid, while the solid receiving that fluidifying cause became fluid. And wherefore is it that the solid cream has become *surrounded* by the fluid? Wherefore is it that the result has assumed the form of a nucleus surrounded by an envelope? Wherefore, in a word, have we produced, if I may so term it, *a nucleated cell?* It is because on parting from a body (or, if any of my readers should prefer the expression, *on ceasing to manifest its influence upon a body)* caloric *radiates* (or exercises its influence) *centrifugally and in every direction.* Having reflected for a moment upon this process, and having distinctly before their minds the changes which take place, their nature and their cause, let my readers now substitute for the cream and its envelope of snow and salt, two substances of a very different nature, and observe the striking analogy between the changes which take place in the substituted substances and those which we have just been considering.

"Let them, in imagination, substitute in the foregoing experiment for the nucleus of cream (while in its original fluid condition) the first or humblest of our organizing atoms; or in other words, the embryonic germ of the simplest conceivable of vegetations. This granule I shall suppose, for the sake of argument, to be so extremely minute as to be invisible even under our highest magnifying powers. Let them further, for the originally solid envelope of snow and salt in our experiment, substitute certain components of the inanimate or inorganic world—say, for instance, carbonic acid, or carbonate of ammonia, and water. Let them, in addition, in place of the word *fluid*, as applied to the nucleus of cream, substitute the word *organized*, as applied to the new nucleus (namely, to the germ of the simplest of vegetations); and for

the word *solid*, as applied to the envelope of snow and salt, substitute the word *inorganic*, as applied to the new envelope —that is, to the inanimate or inorganic matter, such as carbonic acid, or carbonate of ammonia, and water. What have we then at the *commencement* of our second experiment? We have the germ of a simple vegetation surrounded by an inanimate world. We have an organic nucleus surrounded by an envelope of inorganic matter. We have, in a word, *an organizing agent surrounded by unorganized elements.* Such is what we have at the commencement of our experiment; but what are the changes which subsequently take place? I may express those changes concisely in the following words—namely, 'Except a corn of wheat fall into the ground *and die*, it abideth alone; *but if it die*, it bringeth forth much fruit.' Thus the living or organizing nucleus *must become dead or inorganic*, while in doing so it confers life or organization upon unorganized or inanimate matter. Will my readers question that an interchange in their respective conditions has taken place between the nucleus originally organic and its inorganic envelope, *the former having assumed the condition which the latter originally held, while in doing so it has conferred upon the latter its own original condition.*

"And what was the cause of this interchange of condition? Few, I feel assured, will question it must be this—namely, that the principle, whatever that principle be, which, before the experiment, retained the components of the organizing agent in the organized condition was (when exposed to the influence of matter which had for that principle an affinity) imparted by the organizing agent to the surrounding inorganic matter; the consequence of which was that the organizing agent having parted with the *cause* of its organization became inorganic, while the surrounding inorganic matter receiving that organizing cause became organized.

And wherefore is it that the organizing agent has become *surrounded* by the inanimate matter? Wherefore is it that the result has assumed the form of a nucleus surrounded by an envelope? Wherefore, in a word, have we produced *a nucleated cell?* It is because on parting from a body (or, if my readers prefer the expression, on ceasing to manifest its influence upon a body) the organizing principle, like its analogue caloric, *radiates,* or exercises its influence, *centrifugally and in every direction.* Such, it appears to me, is the manner in which an organizing atom, or so called "cell-germ," generates a cell, and such appears to me to be identically analogous to the manner in which a body radiating caloric may become surrounded by the matter to which it imparts its caloric."*

Having, then, directed attention thus briefly to somewhat of *the manner* in which, as I conceive, an organiz*ing* agent or embryonic germ discharges its physiological function of conferring or imparting organization; and having shown *how,* as it appears to me, one result of that function is the developement or generation of what has been termed "a nucleated cell," I shall now proceed to point out how, as I conceive, that cell and its contents are to be ultimately disposed of.

This brings me at once to the consideration of my third and fourth deductions in relation to the question of "cytogenesis," or "cell-growth." The third and fourth deductions to which I refer are as follows, viz.:—3rd. "That organiz*ing* agents so exist in nature as to constitute an unbroken chain of distinct organisms, gradually ascending in the scale of organization, from the humblest 'cell-germ' in the vegetable world to the most elevated *simple* organism which enters into the composition of man;" and 4th. "That the specific function of each link in the chain of organizing atoms—that

* Freke in *The Dublin Medical Press,* 3rd September, 1851.

is, the special function of each individual so-called 'cytoblast' or 'cell-germ,' is to generate or create a specific species of organized matter which is essential, and which alone is competent, to call into operation the specific function of the link or 'cell-germ' next above it in the ascending scale of organisms: between which specific species of organized matter and the 'cell-germ' which it is capable of calling into action, Nature has placed a strong force of attraction; and that thus, through the agency of this specific product of each species of organizing atom, we have the various links in the organizing chain united, or as it were cemented together."

I shall make a few observations upon each of these deductions. That organizing agents do actually so exist in nature as to constitute a gradually ascending chain of organic entities whose function is to confer or impart organization, would appear to me to be a fact which no reflecting physiologist can question. I shall here quote my former observations on this question:—

"Let my readers ask themselves what they mean by the expression 'organic' or 'organized'—what they mean to express when they say of such or such matter it is organized or organic in contradistinction to matter which is said to be unorganized or inorganic? Every one is aware that *one* meaning included in that expression is, that the components of such matter preserve among themselves a certain relative arrangement as to position and distance which differs, or is distinct, from the arrangement which the same components would assume, if abandoned to the free and exclusive control of the ordinary laws of physics and chemistry, and that in consequence of this distinction in the arrangement of its components, the compound is possessed of a new order of properties, to which properties we give the name '*organic*.' Every one is aware, for instance, that the meat we eat is what is termed *organic*, and that the salt named carbonate of

ammonia is called *inorganic;* and every one is aware that notwithstanding the vast distinction in their properties between these two species of matter, the components of each are almost identical, so much so, that if such meat be abandoned to the free and exclusive control of physical and chemical laws, it will, to a great extent, eventually become carbonate of ammonia. Now, upon what does this difference in the arrangement of the components of these two very different species of compound depend? By what means has it been accomplished that the elements of carbonate of ammonia have assumed this new arrangement which gave to the compound this new order of properties? By what means, in other words, does inorganic matter become organized? That question has already been discussed, and I feel little doubt that there are but few of my readers who do not feel fully convinced that it can be solely and alone through the agency or instrumentality of organisms or organizing agents. But the above is not the *only* distinction we can recognize between organic and inorganic matter. The mere fact that the components are differently arranged in organized structures from that in which the same components are arranged in an inorganic compound, and are consequently possessed of a different order of properties, is not the *sole* difference we can perceive between what we term organic and inorganic matter. We find, on the contrary, another well marked and conspicuous distinction. And what is that distinction? It is this. We find that certain organized structures are but *slightly* removed in the properties they possess from the properties which their components would possess if abandoned to the sole influence of chemical and physical laws; while at the same time we find others whose properties are *vastly* distinct from what would be the result if so abandoned. We find, in a word, *degrees in organization.* Thus, for instance, the substance called urea, which possesses a very slight degree

of organization, differs in a very trifling extent in its properties from the physical and chemical properties possessed by carbonate of ammonia, while muscular fibre, which is formed of very nearly the same components, differs most widely in its properties from that salt. Hence we may state, that in proportion as any organized structure differs in its properties from the properties which would be possessed by the compound resulting from the *chemical* union of its components, in the same proportion may that structure be said to be more or less highly organized; or in other words, more or less elevated in the scale of organization.

"Let my readers run over in imagination the various *degrees* of organization (in this acceptation of the term degrees) which may be recognized intermediate between the organized matter formed by a lichen granule and the cerebral matter of man. The question for us now to determine is, *how are these different degrees of organization conferred?* It is scarcely necessary for me to call my readers' attention to the *gradually progressive* nature of the advance which takes place in every transition from an humbler to a more elevated degree of physiological development. They have but to look around them to be convinced of the universality of this law. They do not see the seed to become *suddenly* a shrub, or the shrub to become *suddenly* a tree. They do not see the infant to become a youth, or the youth to become man without each having passed progressively and gradually through fixed and prescribed stages of advance. The same is *universal* throughout nature. No great transition in physiological development can any where be seen occurring *abruptly*. What is progressive development in physiological language? It is the conferring of *degrees* of organization. Why is it that man cannot (like the simplest vegetation) live upon carbonate of ammonia and water? Simply in consequence of the existence of this law. Simply because mineral matter

requires to be gradually and progressively raised step by step in the scale of organization; or, in other words, requires higher and higher degrees of organization to be gradually and progressively conferred upon it, before it is sufficiently highly organized or raised in the scale of organization to act as the specific stimulus of the various component organizing atoms which in combination constitute the compound organism, man. Had not nature with wise design enacted this law, animals and man might have formed their required organized structures (such as muscles, glands, nerves, &c.) from the inanimate elements of earth, and a vegetable creation would not as now be required to prepare its nutriment for an animal world. Now it must be obvious to my readers, that it would be most preposterous to suppose that any organism could confer a higher degree of organization upon other materials than that organism was possessed of itself; in other words, that an organism could impart that which it did not possess. Were such supposed possible, it would be a direct infringement upon the law of progressive development, and there might be nothing to prevent a lichen granule from forming the cerebral matter of man. We have further seen that it would be irrational to suppose that inanimate or inorganic matter could spontaneously become organized. It would be equally irrational to suppose that organized matter, when organized, could spontaneously *augment* its own organization—could raise itself in the scale of organization. Were such supposed possible, there might be nothing to prevent the organized structure formed by the simplest vegetation from spontaneously becoming muscular fibre; and the humblest species of vegetation that is now in existence would be all that would be required for the formation of all the various organized structures in being. Hence it must be obvious: 1st, that as *degrees* in organization are in existence in nature; 2nd, that as no degree of organization can be conferred except by an

organizing agent; 3rd, that as no organizing agent can confer a higher degree of organization than that organizing agent itself is possessed of; and, finally, that as organized structures are found in nature gradually ascending in the scale of organization, from the organized products formed by the humblest vegetation to the cerebral matter of man, *there must of necessity be a chain of organisms or organizing agents gradually ascending in the scale of organization, from the humblest organism in the vegetable kingdom to the most elevated in the composition of man, whereby these different degrees of organization have been conferred.*"*

I shall now say a word on my fourth and final deduction, which I shall again repeat, as to *it* I would venture to solicit the reader's special attention. It is this, namely:—

"That the specific function of each link in the chain of organizing atoms—that is, the special function of each individual so-called 'cytoblast' or 'cell-germ,' is to generate or create a specific species of organized matter which is essential, and which alone is competent, to call into operation the specific function of the link or 'cell-germ' next above it in the ascending scale of organisms; between which specific species of organized matter and the 'cell-germ' which it is capable of calling into action, nature has placed a strong force of attraction; and that thus, through the agency of this specific product of each species of organizing atom, we have the various links in the organizing chain united, or, as it were, cemented together.†

* Freke, in *Dublin Medical Press*, 10th Sept. 1851.

† "I have stated in the above sentence, in general terms, and for the purpose of avoiding obscurity, that such is the function of *each* link, or of *each individual* so-called 'cytoblast,' or 'cell-germ.' There is, however, an exception to which it is desirable I should direct my readers' attention, and which, when my meaning is clearly understood, will at once be apparent to all. The exception I refer to is this. The various links or organizing atoms *at the top or summit* of the several branches

Perhaps the most simple way of explaining what I desire to convey by this statement is to give the reader an illustration of my meaning. I shall consequently introduce the following quotation from my volume "On Organization," published in 1848:—

"Let us suppose single individuals of the first three species, in succession, of organizing atom, namely, one of the first, one of the second, and one of the third links in our organizing chain, to be so brought within the sphere of each other's action as to admit of the operation of their specific laws—laws (as before observed), it may be said, of a living chemistry. Suppose, too, that in accordance with those laws a mutual affinity exists between these three atoms, the result will be that a union will take place, and a compound organism be

of the organizing chain, can obviously have no link or organizing atom *above them* in that branch, and consequently the residual product, formed by such atoms, cannot be required to call into action the function of an organism which does not exist. Each such link or organizing atom (thus placed at the *summit* of its branch) does however form a residual product, which has some important function to perform in the general organism of which that atom forms a part. It is thus, for instance, as I regard it, that muscular, nervous, glandular, &c., structures are formed, which structures I have elsewhere termed 'the *final* or *ultimate* results of the nutritive process.' I shall endeavour to explain myself more clearly. The entire organizing chain, or chains of successively advancing organisms, appears to me to have been constructed by nature somewhat in the form of *a tree*, in such a manner that although no link in the organizing chain is interrupted or broken, still that chain at a certain point gives off branches in different directions. That is, nature's arrangement appears to me to be thus. The first link, or simplest species of organizing agent, discharges its function (of conferring organization) upon inanimate or mineral matter, and consequently the organizing chain springs, like a tree, from the inorganic or mineral world. As the links of this chain ascend, there is a point, as it appears to me, where branches are given off in different directions; and the link or atom at *the top or summit* of each such branch forms or generates a residual product which has some special function to perform in the general organism of which that link or atom forms a part. I shall

constructed, which will, in all probability, be possessed of something of a symmetrical form.

"In such a compound we should naturally expect that each distinct species of organizing atom should have to perform some essentially important though distinctive part; while the function of all organisms, we can scarcely doubt, is to confer organization.

"Suppose, then, such compound organism placed in the conditions required for the fulfilment of its physiological functions (that is, presented with the necessary inanimate elements in conjunction with atmosphere, and the essentials as to moisture and temperature), what should we expect to result? We should expect that a reciprocal or interchanging action, as it were, would, in the first instance, take place between the first

attempt, by an illustration, to make this more simple. Inanimate or mineral matter is converted into the *simplest* species of organized matter; that is, is raised to the *lowest* degree of organization by the first or humblest species of organizing atom. This organized matter (thus raised to the humblest or lowest degree of organization) may be *elevated* in the scale of organization by an organizing atom of a higher degree of organization; that is, by an atom more elevated in the scale of organization than the first or humblest. It may, for instance, be converted into what we call *albumen*. This albumen, again, may be still further elevated in the scale of organization by a third atom still more elevated in the scale of organization than the second. It may, for example, be converted into what we call *fibrin*. Finally, this fibrin may be raised still higher in the scale of organization by *any one* of the following atoms (all of which appear to me to be placed at the top or summit of their respective branches in the organizing chain), viz., by the muscular, the nervous, the glandular, &c., atom. Now, it is obvious that if the muscular, the nervous, the glandular, &c., atoms have no organizing atom *above* them in their respective branches of the organizing chain, the residual products formed by these atoms (namely, in other words, muscular, nervous, glandular, &c. structure—viz., the *final* or *ultimate* results of the nutritive process), *such* residual products, I say, must have some *special* function in the general organism to perform. Should there be any obscurity in these observations, I trust as we proceed it will disappear."

or simplest of the three atoms and the inanimate elements; the result of which would be, that the atom would elaborate the inanimate elements into an organized mass; that out of this mass it would construct for itself a membranous envelope; would furnish materials which could call into operation a reciprocal action in the second; and, finally, would remodel its type: and thus, having completed at the same time its function and its organic existence, it would be reduced to the condition of inanimate matter. We should expect that a reciprocal or interchanging action would, in the second instance, take place between the second species of atom, and that portion of the mass organized by the first which was destined to be appropriated to that purpose, namely, its residual product; the result of which would be, that the atom would elaborate the organized mass into a mass still more organized; that out of this mass it would construct for itself a membranous envelope—would furnish materials in the form of a residual product, which would call into operation a reciprocal action in the third, and, finally, would remodel its type; and thus having completed at the same time its function and its organic existence, it, too, would be reduced to the condition of inanimate matter.

"And so of the third; it, in like manner, having been called into reciprocal action by that portion of the organized mass elaborated by the second, which was destined thereto, and having produced results in all respects analogous to those affected by the second and first, would, on the remodelling of its type, have no longer organic existence. But what would be the general result of such process? It would be obviously this: we should have the compound organism, as it proceeded in the discharge of its physiological function, gradually becoming augmented in its bulk or dimensions, and as gradually giving development to new species of structure. We should, in obedience to the specific attributes which originally united

the three atoms into something of a symmetrical form, have these new structures, according as they became developed, definitely and symmetrically arranged. We should have three distinct species of membraneous envelope, which may, as we shall hereafter see, become, according to contingent circumstances, tubes, fibres, &c. We should have three distinct organized masses, or, in other words, what we shall hereafter have to call three distinct species of secretion, nerves, muscles, &c.; and, finally, we should have the three types of the original three atoms, (possessed as they must be of the same specific attributes as were possessed by their parents, and consequently urged thereby into the same form of union) constituting an embryonic representative of the original organism, and, in all respects, identical to what that organism had been antecedently to the commencement of its physiological function, and adapted, under similar circumstances, to give development to a similar train of results."*

Again, on the same subject I observe in the *Dublin Medical Press* as follows:—

"My readers are now, I feel assured, convinced of the two following facts—namely, 1st, that an ascending chain of organisms is actually in existence in nature; and, 2nd, that the function of each link in that chain is to organize; that is, to confer organization upon *something*. The question which we are now about to investigate is the following—namely, how is this function discharged? I have already attempted to point out that two essentials are absolutely necessary for the performance of that function in *every* organism—namely, oxygen and some specific stimulus, or some stimulus provided by nature for that purpose.†

* Freke on Organization, (1848) p. 47.

† I have not considered it necessary to occupy my readers' time in my present publication with the consideration of the part performed during vital action by the several other contingencies incidental to that

"The former, my readers are all well aware, has been carefully provided, and there are few of them will suppose that nature has overlooked the provision of the latter. Few of them will suppose that nature has with care supplied the organizing agents, and the oxygen which is to act as their *incidental* stimulus, but has left to mere hazard or chance the provision of the *specific* stimulus of those organizing agents—has left it, in other words, *undetermined* upon what materials, and what *only*, those organizing agents *can* confer organization. Such is not nature's mode of proceeding in her other arrangements, nor has it been her mode of proceeding in this. Had such been the case, man might feed upon the dust on which he treads; and in this respect there is nothing which is peculiar to man. The special materials upon which, and upon which only, each individual organism in existence can, *in a normal manner*, feed (should my readers prefer that expression), have been strictly defined and carefully provided by Nature. And what are those materials? I shall endeavour to answer this question by pointing out the relation in which the several links in the chain of organisms stand towards each other; in other words, the relation which subsists between what I mean to express when I employ the terms, *the different species* of organizing atom. Let me then explain what I mean by those terms. I shall for simplicity number the successive species of organizing atom, one, two, three, &c. By the *first* species of organizing atom, I understand *all simple* organisms which are capable of conferring organization upon *inorganic or mineral matter*, of which species there may exist a vast number of *varieties*. By the *second* species of organizing atom I understand *all simple* organisms which are capable of conferring, not organization upon inor-

process, such as heat, light, electricity, moisture, &c.; my object at present not being to write a treatise on physiology, but merely to attempt to elucidate certain phenomena.

ganic or mineral matter) but *increased* organization, upon a residual product formed by the first species of organizing atom. In this second species of organizing atom there are also several *varieties,* the number of which, however, is, as I conceive, considerably less than that of the first species. By the *third* species of organizing atom, I understand *all simple* organisms which are capable of conferring, not organization upon inorganic or mineral matter, or not increased organization upon the residual product formed by the *first* species of organizing atom; but *still further increased organization* upon the residual product formed by the *second* species of organizing atom; and so of all succeeding species to the last. To me it appears evident (but I could not enter upon that inquiry at present) that the number of the *varieties* contained in each species of organizing atom is gradually diminishing as we ascend in the organizing chain. My readers distinctly understand what I mean by a *simple* organism—that is, an organism which does not admit of physical division without destroying the physiological condition which constitutes it an organism. Let us now inquire what it is which constitutes a *compound* or *aggregate* organism.* Let us suppose single individuals of the first three species in succession of organizing atom (namely, one of the first, one of the second, and one of the third species) to be brought within the sphere of each

* It is a most interesting and important physiological inquiry to ascertain—1stly. What are the several different species of organizing atoms in existence? 2ndly. What are the *varieties* contained under each distinct species? And, 3rdly. What are the varieties in the respective species between which there *is an affinity,* and those between which *no such affinity exists?* The determination of these questions would determine the number of species of living beings which *could by possibility,* in accordance with existing arrangements, exist. The present would not be the place for such inquiry, but at some future period I hope to be able to point out in what manner, as I conceive, such inquiry might be advantageously pursued.

other's action. The result will be, that (if the *varieties* selected be such as *have a natural affinity for each other*) these three atoms must unite and form an integral which will constitute what I understand by a compound or aggregate organism.

"Let us now suppose this compound organism formed. Our next question is, how does *it* perform its specific function? We know how a *simple* organism performs it function—a question which has already been investigated—and I have attempted to make it apparent that it is in a manner closely analogous to that in which the influence of caloric is imparted from one body to another. How, then, does this compound or aggregate organism perform its function? In a manner identically analogous; but we shall attempt to follow the successive steps of the process in detail. This compound organism being composed of three individual *simple* organisms, each of which has to discharge a specific function of its own, we shall consider those three simple organisms in succession, *the function of the three in combination constituting the function of the aggregate organism.* We have already seen that the conditions required by the first species of organizing atom for the discharge of its function, are the presence of oxygen and of inorganic or mineral matter. What, then, should we expect would result when these requirements are present? We should expect, in the first place, that this atom, radiating its influence centrifugally and in every direction, would surround itself with an envelope of inorganic or mineral matter, upon which matter it would confer organization, converting it into *an organized mass.* We should expect, in the second place, that out of this organized mass this atom would form *a residual product*, whose function would be to stimulate to the discharge of its function the *second* species of atom in the little compound organism; which residual product would stand to the second species of atom in exactly the same relation as that

in which the inorganic or mineral matter stood to the first. We should, expect, in the third place, that out of this organized mass this atom would reconstruct an atom of the first species; would, in other words, remodel its own type, which it would deposit in some part of the compound little organism appropriated by nature to that purpose. Such, we should expect, would be the *entire* function of the first species of atom in the compound; which function completed, we should expect to find that atom reduced to the condition of inorganic or mineral matter, having (like the matter which radiates caloric) imparted to other materials *that*, whatever it be, which had originally been the cause of its own organization. And how should we expect that the second atom in the compound would discharge its function? In a manner identically analogous. We should expect, in the first place, that this second species of atom, radiating its influence centrifugally, and in every direction, upon the organized residual product prepared for it by the first, would surround itself with this product, converting it into a mass still more highly organized. We should expect, in the second place, that out of this more highly organized mass this second species of organizing atom would form a second residual product, whose function would be to stimulate to the discharge of its function the *third* species of atom in the little compound organism; which second residual product would stand to the third species of atom in exactly the same relation as that in which the inorganic or mineral matter stood to the first, and the first residual product stood to the second We should expect, in the third place, that out of this more highly organized mass, this second species of organizing atom would reconstruct an atom of the second species; would, in other words, remodel its own type, which, in obedience to the same law of nature, would be deposited with the first reproduced atom in that part of the compound little organism appropriated by

nature for its reception. Such, we should expect, would be the *entire* function of the second species of atom in the compound; which function completed, we should expect that this atom, like the first, and from the same cause, would be reduced to the condition of inorganic or mineral matter. And so of the third. It, in like manner, having been called into action by the residual product prepared for it by the second, and having produced results in all respects analogous to those affected by the first and second species of atom, would, on the remodelling of its type, no longer have organic existence.

"Let us augment the number of atoms in our supposed little organism, and in their place substitute atoms *more elevated* in the scale of organization. Let us give to the substituted atoms the names, vascular, glandular, muscular, nervous, &c. &c., atoms, and what is the result? It is this. *We have arrived at the composition of the embryonic germ of man.* Nay more, it is possible for us to determine with a *certain degree* of precision, as I shall presently attempt to point out, the actual anatomic position or arrangement of the several atoms of which this embryo is composed."*

I have now submitted to the reader in a general way what, as it appears to me, must be the anatomic *composition* of the human embryonic germ, namely, "that such embryo must, as I conceive, be composed of a number of organizing atoms, whose functions are, respectively, to generate what we call vascular, glandular, muscular, nervous, &c. structure. That these several organizing atoms, brought into combination by the laws of organization (or by what with propriety might be termed the laws of organic or living *chemistry*), constitute an aggregate integral, or what I have termed a compound organism, to which compound organism we give

* Freke in *Dublin Medical Press*, 10th Oct. 1851.

the name of the human embryo. I shall now endeavour to point out somewhat more explicitly, how or in what manner I conceive such embryo (as also that of every living being in existence) must of necessity be generated.

"In order that I may be clearly understood upon this topic, which to me appears to be one of considerable physiological importance, I shall, in the first place, for the purpose of illustration, briefly direct my readers' attention to the manner in which a crystallized salt (such, for instance, as the carbonate of ammonia) is formed, that is, how a *compound* atom is formed in the inanimate or mineral world. My reason for doing so is, that I conceive a very striking analogy may be recognized between the manner in which the several component simple inanimate atoms (comprised in that *inanimate* compound) are caused to unite and form a *crystallized salt*; and the manner in which the several component *simple organizing* atoms (comprised in that *organic* compound) are caused to unite and form a compound organism, such as the embryo of man.

"My readers are aware how a crystallized atom of the salt called carbonate of ammonia is formed. It is thus: a simple atom of carbon unites with two simple atoms of oxygen, and forms a *compound* atom which we call carbonic acid. This union of these two different species of matter is caused by what are termed the *chemical* properties of carbon and of oxygen. Again, a simple atom of nitrogen unites with three simple atoms of hydrogen, and forms a compound atom named ammonia, which union is also brought about through the agency of the *chemical* properties of these two species of matter. Finally, these two newly-formed compound atoms (namely, of carbonic acid and of ammonia) unite, in obedience to their *chemical* properties, and form a crystallized compound atom of carbonate of ammonia. Such, my readers are aware, is the manner, and the only manner, in which a crys-

talized atom of carbonate of ammonia can by possibility be formed; and such appears to me to be closely analogous to the manner in which the embryo of every living being must of necessity be formed.*

* I have selected *carbonate of ammonia*, in the above illustration, in preference to other salts, for the two following reasons, namely,—first, because being, as it is, composed of *four distinct species* of elementary matter, it on that account affords a good example of the meaning I am desirous of conveying; and secondly, because we shall hereafter see the very same carbonate of ammonia, or rather the *very same* elementary constituents, which in the inorganic world exist in the form of carbonate of ammonia, presenting themselves in the two other departments of nature in *a very different form*, namely, in the form of vegetable and of animal *organic* structures. We shall, I say, see the *very same* material elements, which we now see existing in the inorganic world in the form of the crystalized salt, called carbonate of ammonia, passing first from that inorganic world into the vegetable kingdom, assuming the form of an organised vegetable, and giving manifestation to *vegetable* life. Secondly, we shall see the *very same* elementary components leaving the vegetable kingdom and passing into the animal, assuming the form of animal organised structures,—such as muscular fibre, nervous tissue, cerebral matter, &c.,—and giving manifestation to the phenomena of *animal* life. And, finally, we shall see the *very same* elementary components returning,—as *the result* of the manifestation of the phenomena of *animal* life,—to the inorganic or mineral world, and again assuming the form of the crystalized salt, carbonate of ammonia, again to resume its circuitous career.

"We see organising agents in the vegetable form conferring organization upon unorganised ponderable constituents, thereby converting them into an organized vegetable, and manifesting through them vegetable life. We see organizing agents in the animal form augmenting the organization of *the same* ponderable constituents, raising them in the scale of organisation, thereby converting them into an organised animal, and manifesting through them animal life. We see the same ponderable constituents, when animal life has ceased to be manifested therethrough, return to their original unorganised condition; again to become vegetable, from which to be reanimalized, and a second time pass to the unorganised state.—*Freke on Organization* (1848), *p.* 29."

The foregoing, I say, are the reasons which induce me to select carbonate of ammonia for illustration; should there, however, be any who may conceive that from the intimate connexion of carbon with organic

"In order to point out this analogy more clearly, my readers will I trust pardon me, if for a moment, for the purpose of illustration, I suppose, in the inanimate or mineral world, an imaginary state of things, which in reality does not or could not exist; but the supposition of which for a moment may enable me to convey more forcibly to the mind of some of my readers my meaning upon a topic upon which I am most desirous of being distinctly understood.

"Let me for this purpose suppose for a moment that it is possible there could be such a thing, in the inanimate world, *as matter totally devoid of all chemical properties whatsoever*—matter which we may for perspicuity term *chaotic* matter. Let us further suppose (for the purpose of illustration) that it is required by Nature that a crystallized atom of carbonate of ammonia (formed, as we have already seen, by a union of four distinct species of *chemical* matter) should so act upon *chaotic* matter (that is, upon matter supposed to be devoid of chemical properties) as to convert that chaotic matter into a crystallized atom of carbonate of ammonia, *in all respects* identical with itself. What, upon this imaginary supposition, must be the process whereby such end, if practicable, could be brought about? The only manner in which I can conceive such end could (upon this supposition) *by possibility* be accomplished is the following.

"The first effect of the atom of carbonate of ammonia upon the chaotic matter must, as it appears to me, be this: namely, the four distinct species of matter in that atom of carbonate of ammonia must, in the first place, respectively

creation,—standing, as it does, in the same relation to the *organic* that silica does to the *mineral* world,—should any, I say, for this reason conceive that carbonate of ammonia has been unhappily selected, they can at will select any other salt they please,—sulphate of potash, magnesia, or soda, nitrate of silver, &c.; my object being simply to illustrate.

impart their chemical properties to the *chaotic* matter, so as to convert such chaotic matter into four distinct species of *chemical* matter—namely, into carbon, oxygen, nitrogen, and hydrogen; while in thus parting with the chemical properties of its components, the original atom of carbonate of ammonia must be reduced to the condition of *chaotic* matter—that is, to the condition of matter devoid of chemical properties; and secondly, the four newly-formed elements (that is, the carbon, oxygen, nitrogen, and hydrogen thus formed out of the chaotic matter) would, in obedience to the chemical properties imparted to them, unite and form a crystallized atom of carbonate of ammonia, which would be in all respects identical with the old atom. Such, I say, is the only way in which I can conceive it possible (upon this imaginary supposition, that such end could be accomplished; for it is required that the new atom of carbonate of ammonia formed from the chaotic matter should be *in all respects* identical with the old, and such being the manner in which that old atom had been formed, to be *identical* such must be the manner of forming the new.

"My readers will pardon this stretch of imagination, which has been indulged in merely for the purpose of illustration Such a thing as chaotic matter I am well aware *does not exist*, and I am further aware that matter possessed of chemical properties *cannot* part with those properties to confer them upon other materials distinct and apart from itself. But such a thing as *mineral* or *inanimate* matter *does* exist; and matter possessed of *organic* or *living* properties not only can, but *does*, impart those properties to inanimate or mineral matter; that is, in other words, to *matter totally devoid of all organic properties whatsoever*. And further, it *has been* required by nature that a living atom, possessed of such organic properties, should so act upon inanimate or mineral matter (that is, upon matter devoid of such pro-

perties), as to convert that inanimate or mineral matter into a living atom in all respects identical with itself. And what do we find to be the process whereby such end is accomplished? It is this. We find *the living atom has imparted its organic properties to the inorganic or mineral matter, and in parting therewith has itself become inorganic.*

"Let us, then, for the word *chaotic* in the supposed case, substitute the word *inorganic* or *mineral;* and for the words *chemical* properties, substitute the words *organic* properties; and we have no longer an *imaginary* state of things to contemplate.

"We have (as we have already seen in the case of the simplest vegetation) the *components* of carbonate of ammonia, but we no longer have those components united in the *crystallized form.* We have those components, though possessed of their chemical properties, restrained by some cause from assuming their normal chemical arrangement. We find them, instead of assuming the crystallized form of an inanimate atom of carbonate of ammonia, compelled (by some cause which it is unnecessary at present to inquire into) to assume the non-crystallized form of an organizing atom, or of an organized living being. We see this organizing living atom acting *not* upon *chaotic,* but upon *dead* or *inanimate* matter, and imparting thereto *not* the *chemical* properties of its components, but the *living* or *organizing* properties itself had originally possessed; while in doing so we see that organizing atom deprived of its own organic properties, and reduced to the inanimate or unorganized condition of a crystallized atom of carbonate of ammonia. And we see, as a result, *a new organizing atom, formed out of inanimate or unorganized matter, in all respects identical with the old.*

"Such is the manner in which the embryo of the simplest vegetation is formed.

"And what is man but the result of the function of a combination of such atoms? What was man originally but a microscopic granule composed of a number of analogous atoms —namely, what we have termed vascular, glandular, muscular, nervous, &c. atoms? If, then, a compound organism, such as man, be required to generate *its type*, I know of but one means whereby it appears to me to be possible that such end could be accomplished, and that means is the following. The several simple atoms, such as the vascular, the glandular, the muscular, the nervous, &c. (which enter into the composition of man), would, in the first place, convert matter (prepared for that purpose by Nature) into simple atoms in all respects identical with themselves; and secondly, these newly-formed simple atoms, in obedience to the organic properties thus conferred upon them, would unite and form a compound organizing atom—namely, the human embryonic type. Such (as it appears to me) is the manner in which the embryonic germ of every living being in existence must of necessity be generated."*

When directing attention to the functional action of a *compound* organizing agent—such, for instance, as that which we supposed to be composed of three *simple* organizing agents, which, in obedience to the laws of organization, had *combined* —I observed that according as each of these three simple organizing agents (as *a part* of its functional action) reproduced its own type, each of these reproduced types, according as the process of development proceeded, was, in conformance with the laws of organic creation, deposited in that portion of the general organism specially provided by Nature for its reception. In the human develope*d* organism we recognize that portion in what is termed the female ovary, and we there see deposited, in the form of the contents of a Graaffian vesicle,

* Freke in the *Dublin Medical Press*, for 17th Sep. 1851.

the several reproduced simple organizing agents which in combination constitute the compound organism—the human embryonic germ. Here that germ may remain till called upon to discharge its physiological function, by the operation of the specific stimulus specially provided for that purpose by nature.

I have one additional word to add upon this subject. When speaking of that imaginary *compound* organism (supposed to be composed of three *simple* organisms in union) I supposed, for the sake of simplicity and to avoid embarassing the reader, that each of those three simple organisms reproduced (along with an organized residual product) *only* a *single* representative of itself, and that these three reproduced simple organisms in combination constituted the embryonic representative of the developed organism. The fact to which I now desire to direct the reader's attention is this—namely; that each of the simple organizing agents comprised in a compound organizing agent, such as the human embryonic germ, while in the discharge of its physiological function of conferring organization, invariably gives development (along with an organized residual product) to a *plurality* of simple organizing agents identical with itself.* *One* of this plurality becomes deposited, as just stated, to contribute to the formation of the embryonic type of the whole; while the others go to the development of

* It is scarcely necessary for me to remind the reader, that every living being has been endowed with the faculty of developing or generating *a plurality* of living beings of its own species. Now it is obvious that *all* organizing agents, whether simple or compound, must of necessity be *living beings*, inasmuch as the act of organizing or of conferring organization is what *constitutes* the phenomena of organic or vegetative life. Consequently, every organizing agent, while in the act of discharging its function, developes or generates—like all other living beings—a plurality of organizing agents like itself. How those which do not go to the formation of the embryonic germ of the vegetable or animal are ultimately disposed of, I shall, in my chapter on developing organs, attempt to point out.

the organized tissues found in the developing and in the fully developed organism. I shall direct attention to this subject again, when we come to consider the question of nutrition, growth, development, assimilation, &c., as they are termed.

Having thus arrived, as I conceive, at the nature of the anatomic constitution of embryonic germs generally, as also the manner in which such embryonic germs are developed and formed; and having further seen those germs deposited in that portion of the organism constructed by nature for their reception, to await there the operation of the specific stimulus specially provided by nature for the purpose of arousing them to the discharge of their physiological function, it now remains for us to inquire into the nature of that *specific stimulus*.

As a preliminary to this inquiry, I must beg permission to say but a single word upon two additional topics—namely, upon *varieties* of organizing atoms and on *compound* residual products. In my former publications I entered somewhat at length upon what I termed the different *varieties* of organizing atom, and of organized residual products. I shall here, however, only reproduce so much as is indispensable to the present inquiry. In referring to what I have termed *compound residual products*, in their relation to *simple* organizing agents, I observe as follows :—

"There are several physiological phenomena which make it apparent that certain organizing atoms require, for the discharge of their physiological function of conferring organization, the presence of what I would call a *compound* residual product. What I mean to express by the term compound residual product is this—namely, an organized mass which has been formed by the combination of two or more residual products, generated either by different species of organizing atom, or by different varieties of the same species. Thus, for example, a combination of fibrin with a peculiar species of fatty matter would form a *compound* residual product, inasmuch as

these two components have derived their origin from different sources. What I now state is, that several physiological phenomena make it apparent that certain organizing atoms require the presence of some such compound residual product to call them to the *normal* discharge of their function. Thus, for the sake of illustration, I shall suppose that a combination of fibrin with a peculiar species of fatty matter is essential to call into *normal* operation the action of the atom whose function is to form nervous tissue. It further appears to me to be necessary that *one* of the components of the compound residual product must of necessity be *but one link* (in the ascending chain of organisms and residual products) below the atom which it calls into action, or towards which it stands in the relation of specific stimulus. I say *one* of the components, because it appears to me that the other or others may be removed further down in the chain.* The present, however, would not be the place to enter upon an investigation of this question."

So much then for compound residual products in their relation to *simple* organizing agents. I shall now make a few remarks upon compound organized residual products in their relation to *compound or aggregate organisms*, such, for example, as the embryonic germ of man; and in such compound residual products we shall recognize the *specific stimuli* specially provided by nature for calling such embryonic germs to the discharge of their function. The following is the manner in which I have expressed myself on this subject :—

"I am now desirous of making a few observations upon compound residual products, in their relation to *compound* or *aggregate* organisms; such, for example, as the embryo of man. I am desirous, in other words, of calling my readers' attention to the nature of the relation which must, as I conceive,

* Freke in *Dublin Medical Press*, 17th September, 1851.

subsist between a compound organism, such as the human embryonic germ, and the compound residual product which is capable, and alone is capable, of arousing that organism to the discharge of its specific physiological function—the relation, in a word, which subsists between that embryo and what I have termed its *specific stimulus*, or the stimulus provided by nature for calling into operation its physiological function."

Perhaps it might facilitate the reader if, on entering upon this question, I were to throw into a single paragraph, in the form of a rapid recapitulation, the leading points I have hitherto been attempting to establish.* I shall do so in the following quotation :—

"I have already directed my readers' attention in a general manner to what I conceive must be the anatomic composition of that embryonic germ, and have endeavoured to make it apparent (from the functions which it is called upon to discharge—namely, *to generate a number of distinct individual organized structures*)—I have, I say, endeavoured to make it apparent that such embryonic germ must of necessity be formed by the organic or physiological union of a *number of distinct individual organisms or organizing agents.* I say must (as I conceive) *of necessity* be so formed, inasmuch as it is alone by an organism or organizing agent that any organized structure can by possibility be generated. To each of those organisms or organizing agents I have (for reasons of which my readers are in possession) given the name *organizing atom.* And to the several organizing atoms comprised in that embryo (inasmuch as the function of those atoms respectively is to generate what we term nervous, vascular, muscular, glandular, &c., structure ; that is, to generate the various organized structures which eventually constitute *man*)—to the several organizing atoms, I say, comprised in that embryonic germ, I have given

* Freke on the Pathology of Inflammation and Fever in *Dublin Medical Press*, 1851.

the names respectively of the nervous, the vascular, the muscular, the glandular, &c. atom. These various atoms in combination constitute an *aggregate* integral, the function of which integral is to *organize*. And every aggregate integral possessed of such function affords an example of what I mean to convey by the terms *compound organism*. The compound organism which at present engages our attention is that known to us by the name of the embryonic germ of man.

"Nor is this the utmost limit to which, as it appears to me, our analysis of the anatomy of the human embryonic germ, &c. can be carried. We can, as I conceive, pursue our enquiries still further, and determine with the strictest precision the number of *varieties* of organizing atom which must be contained in that germ. Thus, for example, we know that two varieties of nervous and of muscular atom must exist to generate the two varieties of nervous and muscular structure known as voluntary and involuntary. We further know that such embryonic germ must contain a considerable number of varieties of glandular atom; all of which can be determined with the greatest degree of precision. And so on of all its other components, till we have arrived at the absolute composition of that embryonic germ. Nay more, we may be enabled to determine, with a certain degree of accuracy, even the *relative arrangement* or *position* of the various atoms in that germ. For as we can *see* what *is* the relative arrangement of the organized tissues which constitute the fully developed individual, so we can *conclude* what *was* the relative arrangement of the organizing agents which gave to those tissues their development. And thus do we arrive at the *components and their relative arrangement* of embryonic germs generally, notwithstanding such germs may be microscopic.

"Such, I have attempted to make it appear, must be the composition of the organism which has been destined by nature to generate *(when placed in the circumstances adapted*

for that purpose) the various species of organized structure which are eventually to be found in the constitution of man.. The question which is now about to engage our attention is this, namely, *What are those circumstances?* What are the conditions which nature requires should be fulfilled before the function of that compound organism can commence—before that organism can *manifest* life?

"It must be obvious to my readers, from what has been already advanced, that this compound organism (or organizing agent) must of necessity remain inactive or dormant—that is, must remain in a quiescent or passive condition—till it has been presented with those requirements which nature has made essential to every organism (whatever be it nature, whether simple or compound) before that organism can discharge its specific physiological function. My readers are already acquainted with the nature of such requirements, and are aware that one of the requisites essential to the performance of the specific function of every organizing agent is the presence of materials upon which that agent can confer organization; the presence, in a word, of materials which stand to that organizing agent in the relation of what I have termed its specific stimulus. Whence are those materials derived for the organism in question—namely, for the compound organizing agent which we term the embryonic germ of man?

"It must (as it appears to me) be from a source that is foreign to itself, and hence *we arrive at the necessity* (as I conceive) *for distinctions in sex.* One parent is required to generate the *embryonic germ*, and another parent to generate an organized residual product upon which that embryonic germ can exercise its function.

"In *one* parent of all vegetables elevated in the scale of organization above the condition of *agamic* plants—in one parent of such vegetables, I say, the various regenerated *organizing atoms* combine, and in union constitute an ovule, or the em-

bryonic representative of the species; in *the other*, the various *stimulants* or *residual products* (required by those atoms in that ovule which demand to be *simultaneously*, at fecundation, called into operative action) unite to form that mysterious compound known to the botanist as pollen. In *one* parent of the organism which we term the embryonic germ of man, regenerated nervous, vascular, muscular, glandular, &c. *organizing atoms* (urged into union by the laws of organization, and by the same laws deposited in that portion of the human mechanism appropriated to that end), constitute man's embryonic representative in the form of the contents of a Graaffian vesicle. In *the other*, elaborations and compound elaborations—namely, what I have termed *organized residual products* (of such high organization as may call into functional action the various atoms in that embryo which, at the instant of conception, must spring into *simultaneous* operation), *in their accumulated form constitute man's regenerative sperm*. In this mystic secretion must be contained everything the embryonic germ requires on which to manifest its earliest life. This residual product must, in a word, bear to the compound organism—the human embryonic type—the same relation which the inanimate elements of earth bore to the humblest conceivable of vegetations—the same relation that the liquor sanguinis of our blood bears to the fœtus and to man.

"In the foregoing observations, in relation to the various atoms in the ovule and in the embryo which require to be called into action at the moment of fecundation, I have used the words, "which demand to be *simultaneously* called into operative action," and which "must spring into *simultaneous* operation." I shall explain my motive for employing those words. My readers will observe, from what has already been advanced, that a striking and marked distinction (in the requisites for fecundation) must necessarily exist between one of the simplest or most humble species of organizing atom in-

dividually and alone, and a *compound* organism composed of a plurality of atoms of different species, that is, of *different degrees of elevation in the scale of organization;* or composed of atoms some of which require the presence of *compound* residual products. I have attempted to make it apparent that the humblest conceivable vegetation is composed of but a single *individual* organism (namely, a solitary organizing atom), and that the *only* specific stimulus required by that organism on which to discharge its specific physiological function (of conferring organization) is certain species of *inorganic* or *mineral matter.* When this specific stimulus is present (with the additional presence of its *incidental* stimulus, and the other requirements, such as temperature and moisture, &c.)—when, I say, *this* specific stimulus is present, that organism, or organizing atom, can *complete* its *entire* physiological function without the presence of any additional requirement—without, in a word, the presence of any *organized* residual product. Hence it is apparent that *this* organism, or organizing agent, can have no necessity for a *plurality* of parents. A *single* parent is required to *regenerate* that *atom;* but no parent is required to generate an *organized residual product,* to stimulate the *offspring* atom to the discharge of its physiological function. The residual product (if I may so term it) required by that offspring atom for that purpose, has been already provided by Nature in the mineral or *unorganized* world. Hence that atom has no necessity for an *organized* residual product—hence it has no necessity for *a parent to generate such product.*

"But such is far different with regard to *compound* organisms. Such must, of necessity, be far otherwise with respect to organisms which comprise in their composition *different species* of organizing atom; such, for example, as the embryonic representative of the loftier vegetations, of animals, and of man. I shall endeavour to convince my readers of

this distinction, and to show wherefore, in the case of *such* organisms, there is (as it appears to me) a necessity for a plurality of parents.

"I attempted to point out (in the case of the supposed organism which I selected as illustrative of the nature of a *compound* organism, namely, that which I supposed to be formed by the union of three individual atoms selected from the first three species of organizing atom in succession)—I attempted, I say, to point out the nature of the relation in which the three *simple* atoms (comprised in the composition of that *compound* organism) stood towards each other. That relation, I endeavoured to make it appear, was the following —namely, that the first or simplest of the three atoms in the compound, formed or generated *(out of inanimate or mineral matter)* an organized residual product which was capable of calling into operation the function of the second species of atom; and that the second species of atom formed or generated *(out of the organized residual product prepared for it by the first)* a more highly organized residual product, which was capable of calling into operation the function of the third species of atom. It is hence clearly obvious how, by means of inanimate or mineral matter, *exclusively* and *alone* (that is, without the additional presence of any other specific stimulus—without the presence of any *organized* residual product)—it is, I say, clearly obvious how, by means of inanimate matter, exclusively and alone, the three atoms in that supposed compound organism could *successively (but not simultaneously)* be called into physiological operation.

"That is, when the first species of atom had *completed* its function—namely, had generated an organized residual product out of inanimate or mineral matter, *then*, and *not till then*, could the function of the second species of atom *commence;* while it is not till a *still later period* (namely, not till the function of the second species of atom had, in like

manner, been *completed)* that the third species of atom in that compound could *commence* its physiological function.

"It thus becomes obvious that if mineral matter, exclusively and alone, be supplied as its specific stimulus to that compound organism, the component simple organisms of that compound can only be *successively* (and not *simultaneously*) called into physiological action.

"Now, if it be required that *the three atoms* in that compound organism should *simultaneously* discharge their physiological function from the *very commencement* of the functional action of the compound; that is, if it be required that the first, second, and third atom in that compound should *all three at the same moment* commence the performance of their function, it is obvious that inanimate or mineral matter, exclusively and alone, would be utterly incompetent to bring such end about. Inanimate or mineral matter is *only* competent to call into operation the function of the *first or simplest* of those three atoms, and could be no more competent to call into operation the physiological functions of the second and third species of atom in that compound, than it could be competent to call into operation the physiological functions of the various atoms comprised in the compound organism, man.*

"If, then, I say, it be required that the second and third species of organizing atom in that imaginary compound or-

* Present inorganic or mineral matter, exclusively and alone, to the compound organism, man, and what is the result? The result is this, namely, that that organism *ceases to discharge its physiological function.* And what is the cause of this result? The cause is simply this, that *no organized residual product* has been presented to the various organizing atoms in that compound organism upon which those atoms can discharge their physiological function of conferring increased organization (that is, in other words, their physiological function of generating, out of matter *less highly* organized, the various organized tissues in man), and, consequently, the function of those atoms must of necessity cease.

ganism, should commence the discharge of their physiological function *at the same moment* that the function of the first species of atom is commencing, how could this end be accomplished? *It can alone,* as it appears to me, *be accomplished through the agency of a plurality of parents.* I shall endeavour to explain myself more clearly. The *three* atoms are, we suppose, required to commence their physiological operation *simultaneously;* hence it is obvious that *two organized* residual products (namely, one to call into operation the function of the second species of atom in the compound, and another to call into operation the function of the third)—it is, I say, obvious (as it appears to me) that *two organized* residual products must necessarily be derived from *some source or other,* to call into operation the physiological function of the second and third species of atom in the compound. It is, in a word, obvious, as I conceive, that before this imaginary compound little organism can *commence* the discharge of its physiological function, it must be presented with *a compound organized residual product,* derived from some source or other, which can stimulate (that is, call into action) its second and third species of atom; inasmuch as we have supposed that those atoms are required to be in operation *at the commencement* of the function of the compound. Now there is *one* source, and *but one source alone,* from whence an organized residual product *can by possibility* be derived—namely, *it must be generated by an organism or organizing agent.* Hence the necessity, as it appears to me, for an organizing agent to generate a compound organized residual product, which can call into operation the function of the first and second species of atom in that organism. Hence, in other words, the necessity for a *second parent* to generate *that* whereon this compound organism can *commence* the discharge of its physiological function—can *commence* the *manifestation* of vitality.

"That such supposed state of things is what *actually is required* with regard to the component organizing atoms comprised in the constitution of the embryo of the loftier vegetations of animals and of man, I shall now endeavour to make apparent to my readers.

"Let us, in place of the supposed compound organism which we have just been contemplating,—namely, that which we regarded as composed of three *imaginary* atoms, the function of which three atoms we supposed it was required should commence *simultaneously*—let us, I say, in place of this supposed compound organism, substitute the compound organism known to us as *the embryonic germ of man*. With the composition of *this* organism we have already made ourselves acquainted, and *its* components are no *imaginary* atoms. The nature of that compound and the nature of its function are known to us, and consequently the nature and function of its components. And what do we know with regard to the nature and function of this compound and of its components? We know the following two facts—namely, 1st. That this *compound* organism is composed of a number of *simpler* organisms, whose functions respectively are to generate what we term vascular, glandular, muscular, nervous, &c. structure. And, 2nd. we know that certain of those simple organisms require the presence of a *compound* organized residual product to enable them to generate the required organized structure. So much, as it appears to me, we know as regards the nature and function of the several organizing atoms comprised in the composition of that compound.

"But do we know anything as regards *the period* when it is required that those several atoms should respectively *commence* the discharge of that function—should *commence* the generation or development of the various structures they are respectively called on to generate? Do we, in other words, know anything in relation to *the time* when it is requisite

that the development or generation of the various tissues found in the *fœtus* of man (that is, of vascular structure and of gland, of muscular structure and of nerves, of osseous tissue, &c., &c.)—do we, I say, know anything as regards *the time* when it is requisite that the development or generation of these various tissues *should commence* in the *embryo* of man? I conceive we do. I conceive we know *this* to be requisite—namely, the generation or development of *several* of those tissues must, as I conceive, of necessity commence *simultaneously,* and that at the *commencement* of the functional action of the embryo. For, were it otherwise, nature's design in the formation of that embryo could not, as it appears to me, be accomplished; but such design must, as I conceive, of necessity be frustrated.

"For what was nature's design in the formation of that embryo? It was that it should generate man, *between the various tissues or organs of which man, when developed, there should exist a perfect unity or harmony of function.*

"Now, if the function of *several* of the component organisms, contained in that embryo, *had not* commenced *simultaneously,* and that at the *commencement* of the function of the embryo, it appears to me that the *relation* now observed, and which must of necessity be preserved, with regard to their relative stages of development)—it appears to me, I say, that the relation in *development* between several of the organized structures found in the fœtus of man could by no possibility exist. The result, as it appears to me, must of necessity be this—namely, that when the development of that fœtus had arrived at completion, the *utmost confusion* must prevail between the functions respectively of its several organs; for no harmony could be preserved between the *functions* of its structures, if none had been observed between their *development.* In place of the *symmetry* now recognizable throughout organic creation, we should everywhere encounter *de-*

formity. For the slightest disturbance of this balance of relation, between the development respectively of the several tissues of the embryo, must give origin to some form of congenital defect.*

"If, then, it be required that at the *commencement* of the functional operation of the embryonic germ of man, which we have already seen generated by *one* parent, several of its component organizing atoms (some of which require the presence of a *compound* residual product) should be *simultaneously* called into operative action, there is but one means, as it appears to me, whereby such end could be accomplished, and that means is, as I conceive, the following—namely, *another parent* must have pre-existed to generate such *organized residual products* as nature has made essential to the performance of the function of those several atoms."†

In the foregoing observations I have laid before the reader my views upon *the nature*—first, of the *constitution;* secondly, of the *function;* and, thirdly, of the *mode of the formation*—of embryonic germs generally. Before taking leave of this subject, and proceeding to point out how in accordance with those views I conceive organic creation as it now exists has been developed; before, in a word, pointing out what I desire to convey by the expression, "*the origin of species by means of organic affinity*," I shall briefly recapitulate what I have already advanced,

* I should gladly dilate upon a topic which to me appears to be one of extreme physiological interest, and should be desirous of attempting to point out to my readers the several structures in the fœtus, the generation of which, it appears to me, must necessarily commence simultaneously at the commencement of function of the embryonic germ. I should be also anxious to lay before my readers what I conceive to be the nature of the various structural changes which must as, it appears to me, of necessity take place during the period of fœtal existence. The present, however, would not be the appropriate place for so doing.

† Freke in *Dublin Medical Press*, 1851.

so as to place it concisely before the view of the reader, and enable him at a glance to see clearly my meaning. I shall do so in the following quotation from my publication of 1851 :—

"I have now endeavoured to lay before my readers, in as concise a form as appeared to me to be consistent with perspicuity, an outline of some of the general leading principles upon which I conceive there is evidence that organic creation has been constructed. The views I have ventured to advance are, as I believe, altogether distinct from those generally entertained upon the subject. It has been my effort throughout these observations so to express myself, as to be intelligible to the least informed or least reflecting of my readers, and, by the form of phraseology adopted, to obviate any obscurity or doubt as to the meaning I was desirous of conveying. Aware of the tendency so doing has to embarrass the reader, it has been my study to avoid the introduction of *new terms* into my observations, and, except in such instances as I felt that (consistently with the object in view) such could not be avoided, I have studiously refrained from so doing. The expression "*organizing atom*" and "*organized residual product.*" I found it to be unavoidable to employ, inasmuch as without some such forms of expression I should be unable to convey to others the opinions I myself entertain. From the former of these expressions appearing to me to explain its own meaning, as also for the other reasons which I have already detailed, I have been induced to regard its adoption as desirable; and my meaning in the latter, as also my motive for its employment, I have endeavoured, by illustration and otherwise, to convey to the reader. Apprehensive, however, that with regard to either of these expressions there may possibly, to any of my readers, have been either obscurity or ambiguity in the language in which I have endeavoured to

convey myself, it has occurred to me that it might not perhaps be undesirable, before taking leave of this division of our subject, briefly to recapitulate what has been already advanced. There is perhaps no way in which I could do so more clearly, more forcibly, and at the same time more concisely, than by attempting to lay rapidly before the reader an outline of the striking analogy which I conceive may be recognized between certain of the general leading principles upon which the two great divisions of nature appear to have been originally constructed—that is, the analogy (as regards their *constitution* and *the manner of their formation*) which, I conceive, may be recognized between the objects, respectively, of the inorganic and of the organized world, or of inert and of living creation. Before proceeding, then, to the application of the foregoing views to the question of 'the origin of species,' I shall occupy but a very few moments in an attempt to point out this analogy as a concise means of briefly recapitulating some of the leading points which have already been laid before the reader.

"The globe we inhabit is, as my readers are aware, divided into two grand divisions or kingdoms, named inanimate and animate creation, or what we term an unorganized and an organized world. The former of these divisions, or the unorganized world, is composed, or as it were built up, of a limited number of what we term *distinct species* of mineral matter; to which species respectively (counting about sixty in all) have been given the names—carbon, oxygen, hydrogen, nitrogen, &c. Each of these distinct species of mineral matter has so been originally created as that it shall comprise under it—or, in other words, as that the entire species collectively shall consist of—an incalculably vast number of inconceivably minute particles, which particles, from their supposed physical indivisibility, have been designated *mineral atoms*. By the union of such atoms in various forms of combination (in obe-

dience to what we term their chemical and physical laws) has the inorganic world, as it now exists, been constructed. Thus, then, the vast, the almost countless, forms or varieties of mineral matter which are found throughout inorganic creation *have been formed by the union, in various forms of combination, of atoms of a comparatively limited number of distinct species of mineral matter.*

"Such, my readers are aware, are the opinions now generally entertained as regards the constitution of the inanimate or unorganized world. Such, it is my opinion, is also the case as regards the constitution of the *animate* world, or world of organization. The same, in a word, I have endeavoured to show has also been nature's arrangement in the construction of *living* or *organizing* creation. It, too (as has been my effort to make apparent), is composed, or as it were built up, of a limited number of distinct species of *organizing* matter; and each of those species has, as I conceive, and have endeavoured to prove, been originally so constructed as at *present* to comprise under it an incalculably vast number of microscopically minute granules, to which granules, in consequence of their physiological indivisibility, I have ventured to give the name *organizing atoms.* Thus, then, the vast, the almost countless forms or varieties of *organizing* matter (that is, in other words, of *living beings*) found throughout organic or living creation, have, as it appears to me, been formed, or developed, as the result of the functional action of *a union (in various forms of combination) of organizing atoms of a very limited number of distinct species of organizing matter.*

"In other words, all living creation as it now exists—including all vegetables and animals—has originated from, or has been developed by, embryonic germs, which comprise in their constitution *a very limited number of distinct species of organizing matter.*

"If such be the case (and reflection upon what has been already advanced will, I would venture to hope, convince the unprejudiced reader it is), may we not thus far at least recognize an analogy between the principles upon which nature appears to have originally constructed the *elementary components* of the objects contained in the two great divisions of creation—namely, as all inanimate or mineral creation is reducible to minute particles termed inanimate or *mineral atoms*, so may all *living* or *organizing* creation be reduced to analogous particles, which may appropriately be termed *organizing atoms*.

"Let us now inquire if this analogy can further be traced between the manner in which these elementary components (namely, ultimate *simple* atoms) unite to form *compound* matter in the two great divisions of Nature—that is, in other words, let us endeavour to ascertain if any analogy can be recognized between the manner in which the various different species of *compound* matter are formed in the inanimate or unorganized world, and that in which the various different species of *living beings*—that is, the *embryonic germs* of the as yet undeveloped living beings—are formed in the living world, or world of organization.*

* "Let me be distinctly understood. All inorganic or mineral matter is (as my readers are aware) divisible into *simple* and *compound* matter. Thus, for instance, carbon, oxygen, nitrogen, hydrogen, silver, mercury, &c. &c., are all examples of *simple* mineral matter; while carbonate of ammonia, nitrate of silver, oxide of mercury, &c. &c., (in which *different species* of mineral matter are chemically combined), are instances of *compound* mineral matter. I have already endeavoured to point out that all organisms (viz., organizing agents) are divisible into simple and compound organisms, and have further endeavoured to show that an organism (or organizing agent) *in conjunction with what I have termed a residual product* (that is, in conjunction with something upon which that organism can *confer* organization), is essential to constitute a *living* organism; that is, in other words, is essential to constitute what we understand by a *living being*. My present object is to endeavour to point

"What, then, let us first inquire, *are* the different kinds of *compound* mineral matter which are to be met with in the inanimate or unorganized world? There are but three orders or classes of mineral matter, to some one of which every chemical *compound,* in the inanimate or unorganized world, must of necessity be referred—namely, such compound must either be—first, a *neutral* compound (that is, possessed neither of what chemists term electro-negative, nor of electro-positive properties), such for example as water, as also what we term a neutral salt; or, secondly, it must be a compound possessed of what by chemists have been named *electro-negative* properties; such, for example, as what in chemistry is called an acid; or finally, it must be a compound possessed of what are termed *electro-positive* properties; as, for instance, those compounds to which chemists give the name of alkali or base. To some one of these three orders or divisions of mineral matter (namely, a neutral, an electro-negative, or an electro-positive compound), every chemical compound to be met with in the mineral world must of necessity be referable. In a *neutral* chemical compound (and I would beg of my readers to reflect on this fact), we may have these three orders of chemical compound in combination, constituting an integral or indivisible symmetrical whole. In a crystal of the salt called sulphate of magnesia, for example, we have an *acid and an alkali (by the exercise of those properties or forces peculiar to each as such)* uniting to form what chemists term a *neutral chemical compound.* In every *neutral* chemical compound (and I would desire to impress this strongly on my readers), in

out that the manner in which the various different species of *compound* mineral matter are formed, in the inanimate or unorganized world, is *strikingly analogous* to that in which the various different species of organic compounds (viz., simple living beings, compound organisms, compound residual products, and finally, *complex living beings,*) are formed in the living or organizing world.

every *neutral* chemical compound, I say, in the inanimate or mineral world, we have, as it appears to me, a striking analogue (as regards *constitution* and *mode of formation*) of a *living being* in the living or organizing world. That is, in other words, a striking analogue of an embryonic germ (or the offsprings of such germ) *while in the act* of discharging its function.

"The *electro-negative* element of that neutral chemical compound we may perhaps select as the analogue of the *organism* or *organizing agent* of the living being; in the *electro-positive* element we should then recognise the analogue of the *residual product* upon which that organism or organizing agent is destined to confer organization. In the neutral chemical compound we have the electro-negative and the electro-positive elements, *by the exercise of those properties or forces peculiar to each as such,* uniting to constitute a *neutral* compound. In the *living* being we have the organism or organizing agent, and the residual product to which that agent is about to impart organization, *by the exercise of the properties or forces peculiar to each as such,* uniting to constitute a *living* being. Thus, then, between such neutral compound and such living being, as regards their constitution and mode of formation, there appears to me to be a striking analogy; but I shall endeavour to point out this analogy more clearly.

"We have just seen that in the inorganic or mineral world there are but three orders or classes of mineral matter, to one of which every chemical compound must of necessity be referable—namely, such compound must be either electro-negative, electro-positive, or neutral. We have further seen that the two former of these three classes of compound in combination may produce a compound of the third class—namely, a *neutral* compound. Strikingly *analogous* facts appear to me to be true of the organic or living world. In it there appear

to me to be but three orders or classes of organic matter, to some one of which *every organized structure* must of necessity be referred—namely, such organized structure must either be, first, *an organizing agent*—that is, an organized structure *capable of conferring* organization ; such, for example, what I have named the nervous, the muscular, the glandular, &c. organizing atom, as also the embryonic germ of vegetables, of animals, and of man ; in a word, it must be an organized structure, designed and adapted by nature for *conferring or imparting* organization: or, secondly, it must be an organized structure *not capable of conferring or imparting* organization, but designed and adapted by nature for the performance of some other species of physiological function, to which order of structure I have for perspicuity given the name *organized residual product ;* such for example as albumen and fibrin, as also muscular, nervous, glandular, &c. &c., structure : or, finally, such organized structure may be *a combination or union of these two ;* and such combination or union may constitute what we understand by a *living* being. Of this order or division of organic structures we have an example in a fœtus, in a vegetable, in an animal, and in man. To some one or other of these three divisions or orders of structure every form of organized matter in existence must, as it appears to me, of necessity be referred. Let us now contrast the manner in which the three different orders or classes of compound are formed in the two great divisions of nature, and observe how striking appears to be the analogy between the mode of their formation in each.

" In the inanimate or unorganized world two *simple* atoms —namely, for example, one of oxygen and one of hydrogen, possessed respectively of what are termed electro-negative and electro-positive properties—unite, in obedience to the properties or forces peculiar to each, and form in union *the simplest species of neutral chemical compound.* In the living or

organized world the simplest species of organizing agent (namely, the embryonic germ of the humblest conceivable of vegetations) and the humblest conceivable (if I might so term it) residual product (namely, inorganic or mineral matter), possessed respectively of an adaptation for *imparting* and for *receiving* organization (that is, the organizing agent having been designed and constructed by nature for *conferring* organization, while the so-called residual product (namely, unorganized or mineral matter) was adapted by nature for becoming organized, or, in other words, has been designed and constituted for *receiving* organization)—in, I say, the living or organizing world, the simplest conceivable organizing agent and the simplest conceivable residual product, in obedience to the properties or forces which are peculiar to each, unite, and form in union the simplest conceivable *living* being. I say *living* being, inasmuch as until such union has taken place between that atom and mineral matter, there is no *manifestation* of life. That atom, though *possessed of vitality*, cannot with propriety be said to be *living*. Thus, then, there appears to me to be a close analogy between the manner in which the *simplest* species of *neutral* chemical compound is formed in the inanimate world, and that in which the *simplest* species of *living* being is caused to *manifest* life in the world of organization. Let us see if this analogy can further be traced between the manner in which the more complex *neutral* compounds (such as a crystallized salt) are formed in the inanimate or mineral world, and that in which the more complex *living* beings, such for instance as the human embryonic germ, the human fœtus, or even the full grown man, are caused to *manifest life* in the animate world, or world of organization. In the inanimate or unorganized world we find *simple* atoms of different species of inorganic or mineral matter uniting to form a *compound* atom, possessed of what are termed elec-

tro-negative properties, to which compound we give the name of acid. Thus, for instance, in accordance with the laws of chemical affinity, carbon and oxygen unite, and form the electro-negative compound which we call carbonic acid. In accordance with the laws of the same chemical affinity, *simple* atoms of other species of mineral matter unite and form a *compound* atom, possessed of what are termed electro-positive properties, to which compound we give the name of alkali or base. Thus, for example, in obedience to the laws of chemical affinity, nitrogen and hydrogen unite and form that compound which chemists call ammonia. And, finally, these two *compound* atoms, (possessed respectively of electro-negative and electro-positive properties, in obedience to the properties or forces peculiar to each) unite, and in union constitute a *symmetrical crystallized salt.* So, too, in the animate or organized world, or *living* or *organizing* creation. In it too, we find *simple* organizing atoms, in obedience to the laws of organic affinity, uniting to form a *compound* organizing atom *adapted for imparting or conferring organization.* Thus, for example, the *simple,* nervous, muscular, vascular, glandular, &c. organizing atoms unite to form the *compound* organizing atom—*the embryonic germ of man.* By the laws of the same organic affinity, we find *simple* organized residual products uniting to form a *compound* organized residual product *adapted for receiving organization;* such, for example, as that organized residual product which I have named the specific stimulus of the embryonic germ of man. And, finally, we find these two *compounds* (possessed respectively of an adaptation for *imparting* and for *receiving* organization), in obedience to the organic properties or forces peculiar to each, uniting to form the *living* embryo of man.*"

* The same is equally true with regard to the organism *man*—namely, the result of the function of that embryonic germ. In the compound organism man, the liquor sanguinis of his blood is the *compound residual pro*

Nor does the foregoing appear to me to be the full extent to which we may recognize an analogy as subsisting between the two great divisions of nature; namely, between organic and inorganic creation. To me that analogy would appear to extend not alone to the *constitution* of the objects respectively of the organic and inorganic world, but, in like manner, to the operative action of those great motor influences or forces—be their nature what they may—which give to those objects respectively their *activity*.

Having in my publication of 1848 directed attention to the nature of the connexion which subsists between the ponderable components of inorganic creation, and those imponderable agencies, influences, or forces named gravity, caloric, and electricity, which give to such ponderable components their activity or motion, I thus express myself on the functional action of those forces:—

"Before leaving the consideration of these general forces, we would offer but a word as to their operative *function*.

duct upon which the component atoms in that organism discharge their specific physiological function *of organizing*. That is the residual product upon which the component organizing atoms comprised in the compound organism man *can confer an increased organization*; namely, the compound residual product, which the nervous, the muscular, the vascular, the glandular, &c. atoms, can raise *still higher* in the scale of organization, converting its components into *more highly organized materials*—namely, into what we term nervous, muscular, vascular, glandular, &c. structure. Deprive the organism man of the liquor sanguinis of its blood, and what is the result? The result is this, namely, that the organism ceases to be a *living* organism. And wherefore such result? The organizing atoms of which that organism is in part composed are still in existence, and wherefore are they not still *living* organisms? Why is it that those organisms do not *still manifest life?* Simply because, having been deprived of their *residual product*, there is nothing upon which they can discharge their physiological function of *organizing*, nothing which could enable them to manifest the phenomena of *living*; for an organism or organizing agent, *in conjunction* with a residual product is (as I have endeavoured to point out) essential to constitute a *living being*.

"By the operation of these forces, whether alone or in conjunction with others, is all inanimate matter in being held in constant control—all—alike the ultimate atom and the aggregate mass. By these (whether unaided, or conjointly with aid) is the atom, as the mass, urged into activity, and caused to move throughout space; and by these are the atom and the mass restrained to the assigned limits within which through that space they may range. These, extending their controlling agency to wherever matter exists, range round some universal centre, and consign to a defined distance therefrom everything called matter wherewith space has been furnished. From the great centre of all that is material in creation around which unnumbered and countless spheres are revolving, these universally-extending influences appear ever to emanate; one great function of which is manifestly to assign to all worlds existent their respective positions in the vast universe of worlds—to organize, if that term be admissible, all inanimate matter—in a word, to be the great organizing agencies of all inert creation.

"Let us pause to contemplate in its wonderful vastness all matter, collectively, throughout space's abyss. Let us, viewing universal creation as an aggregate unity, regarding all worlds as harmoniously blended into one, analogically esteem creation as one vast organized structure—an organism of surpassing complexity and mightily compound; wondrous, yet at the same time harmonious; its elements constitute myriads of spheres; its integral parts form distinct solar systems. Those elementary constituents, namely, the countless worlds throughout space, by their relative arrangement constitute this organism's organization. Those integral parts, as our planetary system, give to inanimate creation's vast organism some symmetrical form, while to each, alike to the element and the integral, is assigned the exact position in space it shall occupy; to each, as well to the atom as to the aggregate,

the exact limits within which through that boundless abyss it may stray; and all are controlled into the harmony of unity, and kept in constant activity—we had almost said vitality—by the same great organizing influences emanating from the great centre of all."*

Upon the analogy to which I refer I further express myself thus:—

"Let us again pause to contemplate in their wondrous minuteness these atoms collectively in extreme limits of space. Let us, reviewing this aggregate unity—regarding these three atoms harmoniously blended into one—behold, in the analogue of creation's vast organized structure, an organism of surpassing simplicity and triflingly compound; simple, yet at the same time harmonious, its elements constitute the humblest of organisms, its integral parts form distinct kinds of structure. Those elementary constituents, namely, the three simplest of atoms, by their relative arrangement constitute this organism's organization. Those integral parts, as the *products* of the elements, give to animate creation's minute organism some symmetrical form, while to each, alike to the element and the integral, is assigned the exact position in the organism it shall occupy; to each, as well to the atom as to the aggregate, the exact limits within which through that organism its functions may range, and all are controlled to the harmony of unity, and kept in constant activity, we may now say vitality, by the same great organizing influence emanating from the centres of all."†

The reader who has followed me thus far can now experience little difficulty in understanding what I mean by the expression, "*the origin of species by means of organic affinity.*" What I desire to convey by those terms is simply this, namely, that the different species of vegetable and animal

* Freke on Organization (1848), p. 8. † Ibid, p. 50.

existing throughout organic creation have emanated from different species of embryonic germs, and that these embryonic germs themselves have originated in a union of different species of simple organizing agents, which union of those simple organizing agents has been brought about by *organic affinity*. That is, in other words, this union of the different species of organizing agent, comprised in the embryonic germ, has been brought about by the affinity naturally subsisting between one such species of organizing agent and another; and that consequently the origin of the embryonic germs which have originated the species is the organic affinity referred to. I shall repeat the same statement in other words. What I am desirous of conveying is this, namely, that the *organic* affinity which must naturally subsist between the different species of organiz*ing* atom—analogous to the *chemical* affinity which subsists between different species of *mineral* atom—that this *organic affinity*, I say, has originally forced into union different species of organiz*ing* matter,—different species of *simple* organizing agents,—and has thereby originated various compound organizing agents, which compound organizing agents are the *embryonic representatives* of the various different species of complex vegetable and animal which have since existed in organic creation. This *organic affinity*, I say, has caused the several *different species* of simple organizing agent to combine in a vast variety of forms, as regards, observe, both their *number* and their *relative arrangement*; in all respects analogously to the combinations of mineral elements which we see take place for the formation of the *inorganic* world, as that world is now found to exist.

These combinations of different species of simple organizing agent—combinations differing from each other, bear in mind, both in the *number* and the *relative arrangement* of their respective component different species—these combinations, I say, constitute the *embryonic germs* of the various different

species of vegetable and of animal. These embryonic germs, in the discharge of their function, develope different species of organized beings; that is, species of organized beings *differing* from each other both in the *number* and the *relative arrangement* of their respective component organized tissues.

The reader will bear in mind that, in the commencement of these observations, I endeavoured to make it apparent that the difference in the species respectively to be recognized throughout organic creation *consists*, for the most part, in a difference in the *number* and the *relative arrangement* of their respective component organized structures, viz. bone, muscle, nerve, &c. and that these structures are themselves comprised, for the *entire* of organic creation, in a comparatively limited number of distinct species of organized tissue. The reader is now in possession of my views as to *how* that difference in the number and relative arrangement of those component organized structures has been brought about, or what it is, in a word, which has been *the origin* of that observed distinction.

Such then is my opinion as to "*the origin of species;*" namely, that the embryonic representatives of the different species were first formed by the operation of *organic affinity*, and that subsequently these embryonic representatives, as their special physiological function, developed the different species of vegetable and of animal.

But there is an additional question in relation to this inquiry, which must at once suggest itself to every reflecting mind, and it is this, namely, what has been the *origin* of the *components* of those embryonic germs? Whence have the *simple* organizing agents, which have been brought by the operation of organic affinity into union to form embryonic germs,—whence have these simple organizing agents *themselves* had their origin? In a word, what has been the origin of the countless millions of *individual* simple organizing agents which must now be comprised under each distinct species of organizing matter?

I hesitate not to state, in reply to this question, that to me it would appear to be opposed to all that is known of the great Creator's arrangements, *to doubt* for a moment that all the countless myriads of millions of individual organizing agents, comprised under each distinct species of organizing matter since the commencement of organic nature, have emanated for each distinct species from *one solitary germ of that species.* Who doubts that *all* the individuals of mankind have descended from one such germ? The number of such doubters is *few.* But *few,* too, there are who doubt the same fact with regard to all the individuals comprised respectively under each of the other species of animals. Why, then, I ask, should the *many* doubt the same fact in relation to the individuals of *distinct species of simple organizing agents.*

I repeat, that I hesitate not to state that I myself entertain little doubt on the question, and every new fact that unfolds itself to me in organic creation tends to confirm me in the truth of my opinion. With these observations the reader will be at no loss to understand the following quotations from my publication of 1851, and will at once be enabled to perceive why it is I am of opinion that *all* organic creation—including all vegetables and animals—may possibly have originated from *a single compound embryonic germ* :—

"Organic creation must obviously have had *a commencement.* What was that commencement? What was the condition of the organic world when the organization of inorganic matter *first commenced.* My readers will have the goodness to reflect on this question ; they will have the goodness to carry their imagination back to the period of the *first or earliest* appearance of an organic creation, and a moment's reflection will suffice to convince them that *some* vast distinction must necessarily exist between the condition of organic nature *at the period of its creation,* and the condition of organic creation *at present.* Some vast distinction there

must obviously be between the constitution of the organic world, *at the first or earliest manifestation of organization*, at, if I may so term it, the *birth* of organic nature, and the constitution of that world after organization *has for centuries progressed*, after organic nature has passed through centuries of *development*. And what is that distinction? This is an important physiological inquiry; but does such inquiry admit of a rational reply? Supposing that we are familiar with the constitution of organic creation as *now* it exists, or in its present *advanced stage of development*, are we so circumstanced as to be enabled therefrom to collect *anything* as regards what must have been its constitution at the period when *first* it existed, or at the period, if I may so term it, of its *birth?* I conceive we are. I conceive, that from an accurate acquaintance with the nature and constitution of the organic objects *now* before us, conjointly with the knowledge of the *manner in which those objects have been generated or formed*, we may collect much as to what must have been the nature and constitution of organic creation at the moment when the organization of an unorganized world first commenced.

"The line of investigation which, as it appears to me, should be pursued in such inquiry is the following—namely, I should endeavour to ascertain, first, what is the constitution of organic creation as it now exists; or, in other words, what is the constitution of the *present generation* of organized beings? And, secondly, how, or *in what manner*, has the present generation been *generated* or formed by the preceding generation. A knowledge of these two facts would, as I conceive, furnish us with data from which to collect a certain amount of information as regards the *necessary* constitution of the *origin*, or, if I may venture so to term it, of the *embryo of all generations*. For if the manner in which organized beings universally have been generated can be *accurately* traced back for *one* generation, there is nothing to prevent its

being, with equal accuracy, traced back for *many;* and *the possibility* is that it may, with a certain degree of accuracy, be traced back *for all* generations; that is, in other words, till we have eventually arrived, in imagination, at (if I may so term it) the *embryo of all* organic creation.

"The two enquiries just referred to (namely, the *present* constitution of organized beings, and *the mode of their formation*), I have already endeavoured to investigate, and have laid my opinions thereon before my readers; it remains now for me to apply those opinions to the present investigation—namely, to an inquiry into what must have been the constitution of the *embryo* of all organic creation.

"It is scarcely necessary for me to acquaint my readers with the fact, that one great function of every living being is, and ever has been, to *multiply* the species to which it belongs. One great function for which every existing living being has been created, and which it was consequently designed to fulfil, was (and has ever been since the creation of that living being's *first parent*) to generate an *increased number of individuals* of the species to which that living being belongs. The least observant of mankind requires no argument to convince him that every individual living being, in its normal condition, has been endowed with the faculty of generating a *plurality* of individuals of the species to which it belongs. Such fact is too obvious to require further observation. What do we collect from that fact? We collect this, namely, that the tendency of generation is to increase the number of individuals in a species; or, in other words, that, generation after generation, the number of individuals in the various different species of living beings have, *cæteris paribus*, as a result of generation, been constantly becoming augmented from the time of the *first* existence of such species to the present. That such is the fact there is no one will question. If, then, as I have endeavoured to convince my readers is the fact,

the organic world, *as it now exists*, is composed of individual living beings, all of which have sprung from, or been developed by, embryonic germs, which germs have themselves been formed by the union of a number of minute organisms or organizing agents (which, remember, are also *living* beings)—namely, what I have termed organizing atoms,—if, I say, organic creation, *as it now exists*, is thus composed, it is obvious that, *cæteris paribus*, generation after generation the number of individual organizing atoms (unlike mineral atoms, the number of which is constant and unvarying), —it is, I say, obvious that the number of *individual* organizing atoms comprised under each distinct species of *organizing matter* has been, (and still continues to be) *augmenting;* and that such has been the case, generation after generation, from the period of the *first parent* organizing atom, (at which period a *single individual atom*, in all probability, constituted the *entire species* of that atom at the time in existence) to the present period, when the number of atoms comprised in that species is *countless*.

"If such be the fact, (and perhaps none of my reflecting readers will question or doubt it), let us, in imagination, trace organic nature backward, step by step, from the present time to the period of its creation. Let us, from the countless myriads of organizing atoms that are *now* in existence, pass successively backwards from generation to generation, through the ages that have passed (as the number of those atoms is successively becoming more and more limited), let us, I say, pass backwards till we eventually arrive, in imagination, at the first origin of those atoms; which is, in other words, at the organized world *as that world first existed*. And what do we reach? We reach, as it appears to me, a chain composed of perhaps but a few individual miscroscopic granules. We arrive, as I conceive, at a *single* representative (in the form of a miscroscopic granule or organizing atom) of each

distinct species of organizing matter: we arrive, as I conceive, at the individual atoms which were the first parents of all subsequent atoms,—the first parents of the countless myriads of atoms now in existence.

"These granules constitute what I conceive to have been the *first existing* chain of gradually ascending organisms or organizing atoms. The number of links in that chain may, as I conceive, have been so limited, and their dimensions so minute, as that the entire in combination might, as I conceive, in all probability, have constituted but *a granule of very inconsiderable dimensions.* And what was this granule (or granules)? *It was the embryo of organic creation.* This granule (or granules) was, as I conceive, *one parent* of all since existing organic creation; its *other parent* being, as I conceive, a mineral or inorganic world.

"What! some of my readers perhaps may exclaim, *a granule* (or granules) give origin to an organized world!—give being to a widely diffused organic creation! What! *a granule* (or granules) originate the countless varieties both of vegetable and of animal organism, which in myriads unnumbered, and during a series of centuries, have been spreading life and organization over the entire surface of our globe! Could such be supposed possible?

"I repeat it, that to me, as the result of mature and deliberate reflection, there appears to be evidence to induce the opinion that such is the fact, and, startling or strange as such statement may appear, I would beg of my readers not to reject it without reflecting on what has been advanced. To my mind there appears to be no greater antecedent improbability against such being the fact, than there is against the fact *that the contents of a single Graaffian vesicle could give origin to countless millions of the human race.* I would again beg of my readers *to reflect.*"*

* *Dublin Medical Press*, 19th November, 1851, vol. 26, p. 322.

Again I observe at page 325, as follows, viz. :—

"The following is a concise summary of what I have endeavoured to convey to my readers in relation to what I conceive to have been *the original constitution* of organic creation, as also the manner in which, as I conceive, organic creation, *as it now exists*, has been generated *out of an inanimate or unorganized world*, by organic creation as originally constructed :—

"1. A chain of microscopically minute organisms (or organizing agents) gradually ascending in the scale of organization, appears to me to have been originally created. The entire of these organisms collectively (from the extreme minuteness of each granule, and from their number being probably limited), the entire of these organisms, I say, collectively, *might possibly*, as I conceive, if united, have been comprised within the compass of *a granule of very inconsiderable dimensions*.

"2. To this granule (or granules) being, as I conceive, the origin, or source of the generation of all subsequent organization, I would give the name *embryo of organic creation ;* and the function of this embryo was, as it appears to me, *to organize* what hitherto had been unorganized matter; in a word, to generate an animate or organized world, *out of inanimate or unorganized creation*.

"3. To *each link* in the original chain of gradually ascending organisms, I have given the name of *distinct species of organizing matter*, so that *all the links* comprised in the first existing chain of organizing agents would collectively, as I conceive, constitute all (what I have termed) the different *species of organizing matter* now in existence.*

* In my former publications—and consequently in my present quotations—I applied the term different *species* of organiz*ing* matter to simple organising agents which differ from each other in their *degree* of organization. Thus, the *humblest* description of organizing agent, namely, that which confers organization upon mineral matter—such as the embryonic

"4. The number of such *different species of organizing matter* existing in nature appears to me to be far from consi-

germ of the humblest conceivable vegetation—this, I say, I named an organizing atom of the first *species* of organizing matter. The atom next above this in the scale of organization I termed an atom of the second *species*, and so on, till we reach the atom which gives development to the cerebral matter of man, which I named an atom of the highest *species*.

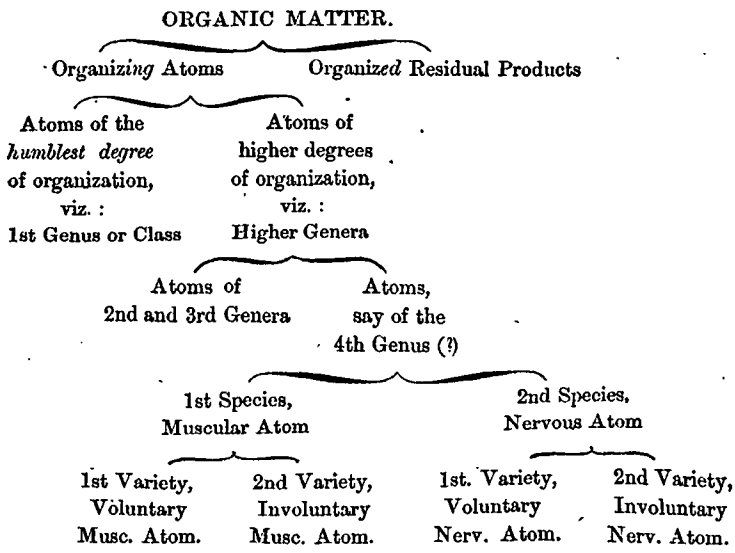
Subsequent reflection has led me to think that perhaps it would be a better classification of organizing atoms, to regard difference in *degree of organization* as constituting distinctions of *genus* or class, rather than of *species*, and to apply the term different *species* to the several different kinds of atom found under the same *genus* or class. That is, to designate as the different species of the same genus or class all such atoms as are possessed of the same *degree of organization*, but which at the same time differ from each other in the kind of organized residual products which they develope. Thus, for example, the nervous and the muscular atoms, both of which are possessed of the same *degree* of organization—that is, both of which occupy the same physiological position in the ascending organic scale—the nervous and the muscular atom would, I say, according to such classification, constitute different *species* of the same genus or class.

If such classification were adopted, we might in the first instance reduce all organic matter universally, to two primary divisions or *orders*, namely, to organizing agents, and organized residual products. As neither of these divisions admits—without a destruction of the physiological integrity of the individuals included under it—as neither, I say, of these divisions admits of a more elementary reduction, I would term organizing agents, and organized residual products the *primary* divisions, or the *orders* of organic matter generally. That is, any *single individual* organic structure which is the object of contemplation, must, of necessity belong to one or other of these two orders, and cannot be reduced to a more elementary condition, without destroying its physiological integrity. I shall illustrate my meaning. Take, for example, albumen, fibrin, lignin, muscular fibre, nervous tissue, &c., &c. Every one of these is comprised under the second primary division or order, namely, they are all organized residual products, and none of them can be reduced to a more elementary condition without destroying its physiological integrity. Albumen cannot be reduced lower than albumen, without a destruction of its organic condition. If further reduced it is no longer a *physiological* entity. The same is equally true of all the other organic structures mentioned.

derable. The *individual* organisms (*now* countless myriads, though at *the commencement* of organic creation, in all proba-

The other primary division—namely, the first order, comprises all *embryonic germs* whether simple or compound.

After this first division of organic entities generally, we should then subdivide our two orders somewhat thus—namely, the first of these primary divisions might then be subdivided into *genera* or classes, each such *genus* or class comprising under it all organizing atoms of the *same degree* of organization—that is, all atoms occupying the *same* physiological position in the organic scale (such as the nervous and the muscular atom) would be atoms of the same genus or class—while the different kinds of atoms contained under the same genus, namely, atoms possessed of the same degree of organization, but whose products have a different species of function to perform (like muscle and nerve)—such different kinds of atoms, I say, represent the different *species* of that genus. And, finally, atoms whose products performed the same *species* of function, but differing in some slight manner from each other—such as voluntary and involuntary nerves, voluntary and involuntary muscles, &c.—such atoms, I say, might be termed *varieties*. The foregoing might perhaps be tabularly represented somewhat thus :—


ORGANIC MATTER.
Organizing Atoms
Organized Residual Products
Atoms of the humblest degree of organization, viz. : 1st Genus or Class
Atoms of higher degrees of organization, viz. : Higher Genera
Atoms of 2nd and 3rd Genera
Atoms, say of the 4th Genus (?)
1st Species, Muscular Atom
2nd Species, Nervous Atom
1st Variety, Voluntary Musc. Atom.
2nd Variety, Involuntary Musc. Atom.
1st. Variety, Voluntary Nerv. Atom.
2nd Variety, Involuntary Nerv. Atom.

Although, such I say, would appear to me to be a better classification of organizing atoms than that which I formerly proposed, I have not adopted it in the foregoing observations, for the reason I have already referred to.

bility, as it appears to me, but a *single individual*) the individual organisms, I say, comprised under each distinct species of organizing matter, being, as I conceive, physiologically atomic or indivisible, I have ventured to name *organizing atoms*.

"5 Every organism, having been endowed with a faculty of generating a *plurality* of its species, the number of individual organizing atoms comprised under each distinct species of organizing matter has (during successive generations) been increased from, probably, one single individual, to the countless myriads which now exist throughout nature.

"6. The function of every organizing agent being *to organize* (that is, to *impart* organization,) the collective chain of organizing agents originally created—namely, what I have termed '*the embryo of organic creation,*' must have had *something* upon which to execute this function—must have something which it could organize, or to which it could impart organization.

"7. That something was (as it appears to me) for the *first* chain of organisms, *the unorganized or mineral world;* and the following appears to me to be the manner in which that function was performed, so as eventually to generate the organized world as that world now exists. In other words, the following appears to me to be the manner in which the *first existing* chain of microscopic organisms so acted upon the unorganized or mineral world as in the course of succeeding generations to have given development to everything called *organic* that has since been in existence,—namely,

"In the first place, I conceive that *the first link* in that chain (or *simplest species* of organizing matter) discharging its function (of organizing) upon *an unorganized* or mineral world; *organized* mineral matter forming or generating therefrom *two distinct classes* of organized product—namely, first, *a plurality of organizing atoms* in all respects identi-

cal with itself, and, like it, capable at some future period of *imparting* organization to *unorganized or mineral matter;* and secondly, an organized product *not capable of imparting* organization, and consequently not an organizing agent, but capable of receiving (increased) organization from the *second* link in the organizing chain. To this second class of organized product I have, for perspicuity, given the name *residual product,* inasmuch as it remains, as it were, *a residue,* till the function of the second link in the chain or second species of organizing atom comes into operation.

"In the second place, I conceive that the *second link* in that chain discharging its function of organizing (not upon unorganized or mineral matter, but) upon *the organized residual product* prepared or generated for it (out of mineral matter) by the first, conferred upon that organized product *increased* organization, thereby *raising it in the scale of organization,* and then forming or generating therefrom *two distinct classes* of organized product—namely, first, a *plurality of organizing atoms* of the second species, in all respects identical with itself, and, like it, capable at some future period of imparting increased organization to organized residual products, to be generated at some future period by the plurality of atoms of the first species which we have just seen reproduced; and, secondly, an organized product *not capable of imparting* organization (and consequently not an organizing agent), but capable of receiving (increased) organization from the *third* link in the organizing chain; to which product I have, for the same reason as in the case of the first link, given the name *residual* product; and so of the several succeeding links in the organizing chain. Each individual link generates, as I conceive, *a plurality of organizing atoms* of the same species as itself; and at the same time generates *an organized residual product.* Each individual atom having, then, been thus endowed with the power of

generating *a plurality* of atoms of its own species, as also a *residual product*, it is obvious that the number of individual organizing atoms, as also the number of organized residual products (which are capable of calling those atoms into action, or upon which those atoms can discharge their physiological function of *conferring organization*), it is, I say, obvious that the number of individual atoms and of residual products existing in nature is, generation after generation, *constantly augmenting*.

"The following is the manner in which I conceive that the various *atoms* and the various *residual products* thus formed were disposed of. I conceive, in the first place, that various *organizing atoms*, thus generated, entering into combinations of various species, various numbers, &c (in obedience to the laws of organization), constituted, in combination, *the first or earliest embryos* of various different species of vegetable and animal; and I conceive, in the second place, that *organized residual products*, thus generated, entering into combination in corresponding variety as to species, &c. constituted, when thus combined, the various compound residual products required by nature to enable those embryos to discharge their physiological function. And, finally, I conceive that these embryos and their residual products (namely, the specific stimuli of the embryos), brought into combination by the laws of organization, developed in union the *first existing* individuals of several different species of vegetable and animal.

"Such is my opinion as to how *the first generation* of living beings has been formed. *How*, as I conceive, subsequent generations have been generated by the first, I have already endeavoured to lay before the reader."*

Should there be any obscurity in these quotations, it will, I trust, at once be dispelled if the reader will have the goodness

* Freke in *Dublin Medical Press*, 19th November, 1851, vol. 26, p. 235.

to recall to his mind what I have already observed in relation to the manner in which I conceive organic creation should, with regard to the present enquiry, be contemplated, namely, that all organic or living beings should be contemplated in relation both to their *constitution* and their *functions*. Even at the risk of being considered tedious, I shall, for the convenience of the reader, repeat what I have said on that subject. With regard to these two relations, *all* organic beings, namely, all animals and plants, should for our present purpose be contemplated under three primary divisions, namely, as embryonic, develop*ing*, and develop*ed* organisms. Although the second of these divisions belongs correctly to that branch of my present enquiry which I have still to investigate, I shall here introduce just so much upon the subject as may be required to render intelligible the foregoing quotations, and shall at the same time recapitulate so much of what I have already advanced on the first division as may serve the same end. I shall say a few words upon each of these divisions under the heads respectively of A and B.

A. Embryonic organisms (viz. in relation to their *constitution*.)

1. Embryonic organisms are constituted exclusively of but one class of organic structure, and discharge exclusively but one physiological function. The constitution of *all* embryonic organisms (animal as well as vegetable) is this :—they consist exclusively of one or more organiz*ing* agents; that is, of one or more organic entities, whose function is to confer or impart organization. Such is the *constitution* of every embryonic organism. The function of every such embryonic organism or organiz*ing* agent being, as I have observed, to confer or impart organization, in discharging this function it gives origin to, or *generates*, two distinct classes of organic structure, viz. a plurality of embryonic organisms or organiz*ing* agents identical with itself, and at the same time some organiz*ed* residual product, such, for instance, as woody fibre, muscular fibre, ner-

vous tissue, cerebral matter, &c. Such, as I regard it, are the constitution and function of all embryonic organisms.

2. A single individual organizing agent, separately and alone, constitutes what I understand by a *simple* organism or simple organizing agent. Of such we have an example in the organizing agents which develop or *generate* respectively woody fibre, muscular fibre, nervous tissue, cerebral matter, &c. as also possibly in the embryo of the simplest vegetations. All such organisms I regard as *simple* organizing agents.

The embryos of loftier vegetations, of animals, and of man, are composed of a plurality of organizing agents; that is, of a combination of two or more *simple* organizing agents. Of such we have an example in the embryo of man, wherein there is a combination of the several agents which respectively generate muscular fibre, nervous tissue, cerebral matter, &c. All such compound embryos I have named compound organisms, or compound organizing agents.

3. From the fact of *simple* organizing agents being, as I conceive, physiologically indivisible, conjointly with the fact of their mode of combining, being, as it appears to me, strictly analogous to that of the combination of the elementary molecules of mineral matter, I have ventured to propose for such simple organizing agents, the appellation, *organizing atom*. A single individual organizing agent—as possibly the embryo of the simplest vegetation—as also the organizing agents which respectively generate woody fibre, muscular fibre, nervous tissue, cerebral matter, &c.—a single individual organizing agent, I say, constitutes what I mean by a *simple* organizing atom, and is analogous to an atom in the inorganic world of carbon, oxygen, hydrogen, or nitrogen.

An *organic combination*—caused, or brought about by what I have termed *organic affinity*—an organic combination, I say, of a plurality of organizing atoms constitutes what I mean by a *compound* organizing atom, and may be said to be analogous, both in constitution and mode of formation, to

an atom in the inorganic world of carbonic acid. Of such compound organizing atoms we have examples in the *embryonic* germs respectively of loftier vegetations, of animals, and of man.

I shall here quote my former words:—

"We find *simple* organizing atoms, in obedience to the laws of organic affinity, uniting to form a *compound* organizing atom. Thus, for example, the *simple* nervous, muscular, vascular, &c. organizing atoms unite to form a compound organizing atom—*the embryo of man* (*Dublin Medical Press*, 19th November, 1851, p. 324); and, again, as quoted before, "various *organizing atoms* thus generated entering into combinations of various species, various numbers, &c. (in obedience to the laws of organization) constitute in combination the *first or earliest embryos* of various different species of vegetable and animal." This, I say, appears to me to have been the origin of species by means of what I have ventured to term *organic affinity*. I need add no more here on the *constitution* of embryonic organisms, but shall pass on to my second division.

B. Develop*ing* organisms; that is, embryonic organisms contemplated *while in the act* of discharging their function.

This is what is understood by what is termed "the phenomena of vegetative or organic life,"—namely, the functional action of organizing agents. It is a process which is common alike to the vegetable and the animal, and constitutes the sole means in both, whereby their organized tissues can be formed, such as woody fibre, &c. in the vegetable; and muscular fibre, nervous tissue, cerebral matter, glandular structure, &c. in the animal. It is the process which in popular language has received the names, nutrition, growth, development, assimilation, &c. It is, in the language of physiology, the process of *generation*, or, if I may so express myself, the process of *living*, that is, of *vegetative* or *organic* living. During this process, the development or generation of two distinct classes of struc-

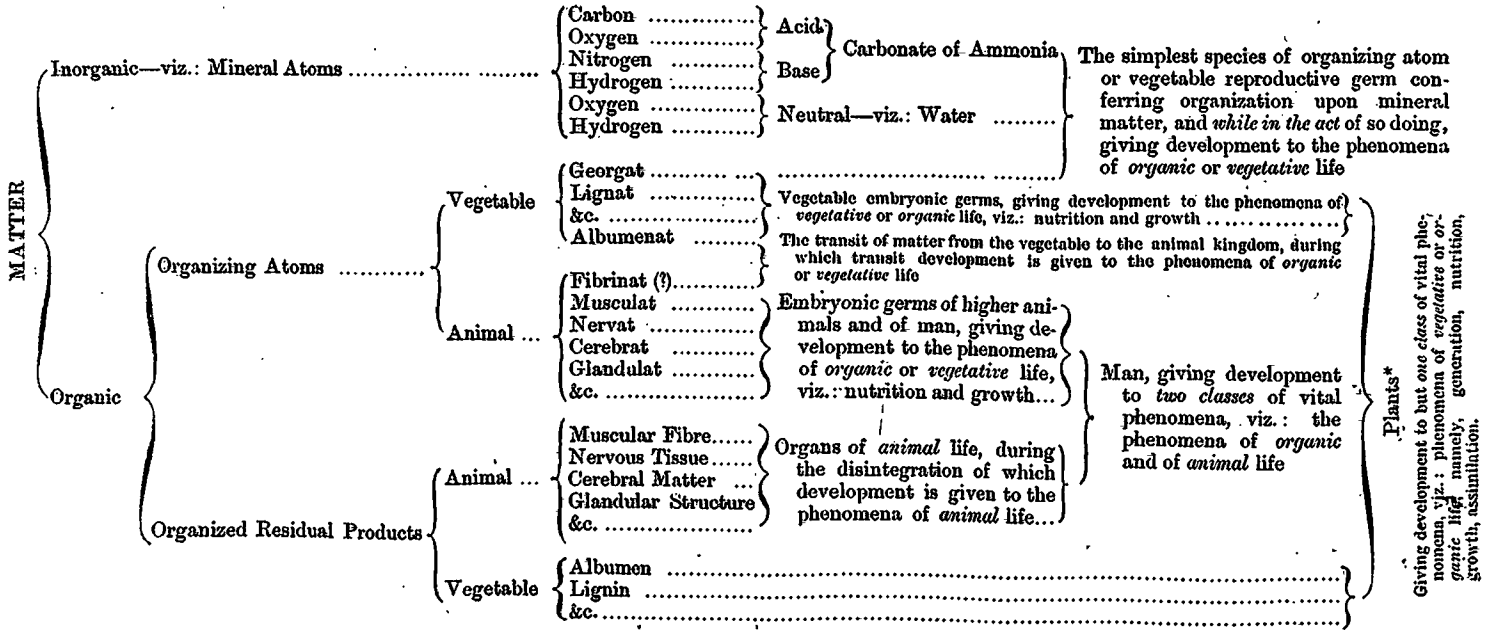
ture takes place, namely, the *re*development of a plurality of offspring organizing agents in all respects identical with the parent, and at the same time an organized residual product, such as woody fibre, &c. in vegetables, and muscular fibre, &c. in man.

Here, then, the reader can understand my reasoning in the foregoing quotations, and can see how it is that I arrived at what I have termed "*the embryo of all organic creation.*" It is thus—*if the foregoing views be correct*—then I conceive that, *even independently* of the argument I have already advanced in support of my opinion—it would not only be unphilosophic, but would at the same time be *limiting*—if I might deferentially so express myself—the foresight of the Creator, to doubt that *all* the woody fibre now in existence, no matter how diffused, has emanated originally from a *solitary organizing atom; somewhat* in the same manner as *all* mankind in existence, though now so diffused, have emanated originally from a *solitary Graaffian vesicle.* I conceive the same to be equally true with regard to *all* muscular fibre, *all* nervous tissue, *all* cerebral matter, *all* the different species of glandular structure, &c. Finally, I conceive all these microscopic granules *may* have been originally combined, and if combined, (their number being inconsiderable) may in combination have constituted but *a granule.*

It is unnecessary for me to add more on the subject.

If now, for the sake of brevity, I might be permitted to designate the first or humblest species of organizing atom—namely, that species which confers organization upon *the inorganic earth*—by some such short appellation as *Georgat;* that which forms albumen by the name *Albumenat;* and those which form respectively lignin, muscular fibre, nervous tissue, &c. by the respective names *Lignat, Musculat, Nervat,* &c. I might then be enabled to throw the leading points I have brought under observation into the form of a chart, somewhat as follows, and thereby enable the reader, at a glance, to recall what has been advanced.

A Tabular view of the relation which subsists between the three kingdoms of nature with regard to organization; including that subsisting between organizing agents and organized residual products, both in the vegetable and in the animal kingdom.


MATTER
Inorganic—viz.: Mineral Atoms
Carbon
Oxygen
Nitrogen
Hydrogen
Oxygen
Hydrogen
Acid
Base
Carbonate of Ammonia
Neutral—viz.: Water
The simplest species of organizing atom or vegetable reproductive germ conferring organization upon mineral matter, and *while in the act* of so doing, giving development to the phenomena of *organic* or *vegetative* life
Organic
Organizing Atoms
Vegetable
Georgat
Lignat
&c.
Albumenat
Vegetable embryonic germs, giving development to the phenomena of *vegetative* or *organic* life, viz.: nutrition and growth
The transit of matter from the vegetable to the animal kingdom, during which transit development is given to the phenomena of *organic* or *vegetative* life
Animal
Fibrinat (?)
Musculat
Nervat
Cerebrat
Glandulat
&c.
Embryonic germs of higher animals and of man, giving development to the phenomena of *organic* or *vegetative* life, viz.: nutrition and growth...
Man, giving development to *two classes* of vital phenomena, viz.: the phenomena of *organic* and of *animal* life
Organized Residual Products
Animal
Muscular Fibre
Nervous Tissue
Cerebral Matter
Glandular Structure
&c.
Organs of *animal* life, during the disintegration of which development is given to the phenomena of *animal* life...
Vegetable
Albumen
Lignin
&c.
Plants*
Giving development to but *one class* of vital phenomena, viz.: phenomena of *vegetative* or *organic* life, namely, generation, nutrition, growth, assimilation.

* The reader will at once perceive that this large bracket, referring to plants, is intended to include within it *exclusively* the two smaller brackets to which its extreme ends point—namely, those referring to veg. atoms and veg. products—and that it has no relation whatever to the central portion referring to man. This, though quite obvious, may have required explanation, as otherwise the chart might appear irregular.

This table may require a word of explanation. The reader will perceive that I have connected carbonate of ammonia and water with georgat, to represent the passage of mineral matter from the inorganic to the organic world. Georgat is there conferring organization upon mineral matter, converting its inorganic elements into an organized vegetable, and manifesting therethrough vegetable life.

While this process is in the act of taking place, *these two entities in conjunction*—namely, mineral matter and georgat; viz., the atom and its "nutriment"—these two entities, I say, *in conjunction* give development to the phenomena of *vegetative* or *organic* life—namely, to what in popular language are termed the processes of generation, nutrition, growth, development, assimilation, &c.

Within the vegetable kingdom, the reader perceives in this chart the same elementary components (viz.: those of carbonate of ammonia and water) gradually and progressively raised to the condition of albumenat. When these material components of carbonate of ammonia and water have attained to this degree of organization—namely, to that of the organizing agent which developes vegetable albumen—when, I say, these materials have reached this degree of organization, they give development to an organized residual product (viz.: vegetable albumen) which is adapted for entering the *animal* kingdom, where it is raised still higher in the scale of organization, to become a component of the animal tissues. The reader thus sees the transit of the *same elementary components* from the vegetable to the animal kingdom. During this transit, development is also given to the phenomena of *vegetative* or *organic* life, viz., nutrition, growth, assimilation, &c.

The reader will observe that in my chart I have connected albumenat in the vegetable kingdom *directly* with fibrinat in the animal kingdom. Such, however, is not strictly correct, and I have done so merely for convenience of arrangement,

and to avoid making my chart too puzzling. The bond of union between albumenat in the vegetable world, and the atom (whether it be fibrinat or otherwise) which in the animal kingdom raises matter still higher in the scale of organization than vegetable albumen—the bond of union, I say, between albumenat and this latter atom, be that atom what it may, is the residual product (viz. albumen) specially prepared by albumenat for that purpose, which albumen I was obliged, for obvious reasons, to place in a distant part of my chart. The reader will further please to remark, that I have placed a note of interrogation after the word fibrinat. I have done so because the true relation in which fibrin stands to the animal tissues is still matter of question. Be that relation, however, what it may, it in no way interferes with the principle I have been attempting to establish. Whether it be what I have termed fibrinat, or be the red corpuscle of the blood, or be some other agent different from either, which prepares vegetable albumen to become a component of the animal tissues, is matter of but little moment to the principle of the present inquiry. *Something* does so, and in our present uncertainty as to what that something is, I have, for perspicuity, adhered to the old opinion in relation to the function of fibrin; at the same time, I have appended a note of interrogation after the word fibrinat, to point out the uncertainty. The starch series of products I have excluded from my chart, in order that I might not render it too complicated.

It is unnecessary for me here to direct special attention to the development of the phenomena of *animal* life, *during* which development the elements of carbonate of ammonia again return to the inorganic world. I shall have to treat upon this subject in a subsequent chapter, when I shall have occasion again to refer to this chart.

This brings me to the close of the first division of my subject—namely, the contemplation of embryonic reproductive

germs universally, in relation to their *constitution*, to the *mode of their formation*, and to the *nature* of their function. We shall now proceed to the second division I have proposed—namely, to the contemplation of the same embryonic germs while *in the act* of discharging their functions—while in the act of giving development to those structures which constitute the individuals comprised under the different species of vegetable and animal.

CHAPTER II.

DEVELOPING ORGANISMS.

VIZ.: EMBRYONIC ORGANISMS WHILE IN THE ACT OF DISCHARGING THEIR PHYSIOLOGICAL FUNCTION OF DEVELOPING ORGANIZED RESIDUAL PRODUCTS AND REPRODUCING THEIR TYPE—NAMELY, WHAT IN POPULAR LANGUAGE IS TERMED THE PROCESS OF GENERATION, OF DEVELOPMENT, OF NUTRITION, OF GROWTH, OF ASSIMILATION, &C.

I SHALL trespass but a very short time upon the reader's attention with either this or the third division of our inquiry, merely directing attention to such points as bear in a general way upon the full development of species, and upon what I conceive to be the true physiological distinction between the vegetable and the animal creation.

I shall confine myself in these observations principally to quotations from my former publications.

Hitherto we have been contemplating embryonic reproductive germs chiefly in relation to the questions of their anatomic constitution and the mode of their formation. I now desire to contemplate such germs *while in the act* of discharging their physiological function—*while in the act*, in other words, of giving development to organized residual products, and to a plurality of reproductive germs like themselves. This it is which constitutes what is termed the phenomena of *vegetative* or *organic* life; namely, the functional action of organizing agents while giving development to organic structures, such as woody fibre, muscular fibre, nervous tissue, &c. and at the same time reproducing a plurality of their own type. This is what, in popular language, has received such names as the process of nutrition, of growth, of assimilation, &c. It is in the language of physiology the process of *generation or development*—namely, the process

whereby embryonic germs generate or give development to the fully developed individuals of the different species. Nay, more, it is the process, if I might be allowed to employ such an expression, *of living*—that is, of *vegetative* or *organic* living. Yes, the functional action of embryonic germs, while *in the act of developing,* is what constitutes organic or vegetative life in both the vegetable and the animal kingdom. I shall here quote from the *Dublin Medical Press* for December, 1851:—

"In order to see this more clearly, it will be desirable to contemplate for a moment the regenerative process as it takes place in the two departments of organic creation—that is, to review it, first, as it occurs in the vegetable kingdom; and, secondly, as it takes place in animals. The function of the simplest conceivable vegetation we have already investigated, and have seen that it was to *generate* a plurality of vegetations of the same species as itself, and at the same time to *generate* an organized residual product. We have further seen that it was during, and alone during the period that such generation was *in progress,* that this simple vegetation, *together with* the materials out of which it generated these two classes of product, *conjointly* constituted a *living* vegetation. It was during, and alone during the period, I say, *that the process of such generation was in actual progress,* that this simple vegetation, and what I have termed its specific stimulus, *conjointly* manifested those phenomena which are essential to constitute what we understand by a *living* vegetation. The process of *generation* or *development,* then, it is obvious, must be what in *this* vegetation *constituted* the process of *living,* inasmuch as such was the *sole and exclusive* process or function which *such* vegetation performed. A very little reflection will make it apparent to the reader that such is also the case with regard to *all* vegetations, it matters not how complex be the nature of their organization. The great

physiological function which the most complex vegetation is designed to perform, is *to generate or develope* (out of materials prepared for that purpose in a manner which we have already investigated), a plurality of the several *simple* organisms which enter into the composition of that vegetation, and at the same time *to generate* a proportional number of organized residual products, such, for example, as albumen, lignin, &c. A very little reflection, I say, will be sufficient to convince all of my readers that *every other process* or function which takes place throughout the entire range of vegetable creation, is merely subordinate or contributory to this one process or function *of generation, development, or reproduction.* Hence the process *of generation* throughout vegetable creation is one and the same thing as the process of *living.* The *effect* of this process is to elevate matter in the scale of organization; hence, I would emphatically define *living*—that is, *vegetative* or *organic* living—to be—*the act of being elevated in the scale of organization;* where and where only *this* act is in operation, there and there only is *living*—namely, *vegetative* or *organic* living.

To what extent the same is equally true with regard *to all animals and to man* I shall now endeavour to point out to my readers, and shall attempt to show that the process of *living* (that is, of vegetative or organic living) is identically the same for *all living beings in existence,* and that such process is simply, in other words, the process *of generation, reproduction, or development.*

"Have my readers ever asked themselves *why* it is that, during the entire period of his existence, man requires to be constantly supplied with what is termed *nutritive matter? Wherefore is it,* in other words, that, *in order to continue to be a living being,* man must continue to be furnished with food? Doubtless they have frequently reflected upon this question, and in reply have perhaps answered themselves thus:

Man requires food for the *nutrition* of the various structures which enter into the composition of his constitution. For the nutrition of his structures! and what is nutrition? What is it which *constitutes* the process of nutrition, and wherefore is there a *necessity* for such process? Have my readers ever seriously reflected on these questions, and have they satisfied themselves as to *what it is* which constitutes nutrition? If not, I would assure them that it is simply, in other words, *generation.* Yes, that process which, in popular language, is termed the process of *nutrition* is, in physiological language, the process of *generation, reproduction,* or *development.* The process whereby the minutest conceivable muscular fibre, *individually and alone,* is *generated* by a solitary individual muscular atom, (which affords an example of what is understood by the process of '*nutrition*') is, as I shall presently endeavour to make apparent to my readers, identically one and the same as that whereby *all the various fibres, &c., &c.,* which are eventually to enter into the constitution of man, are *collectively or in union generated* by the *various* atoms which in combination constitute the embryonic germ of man. The process in both instances is the process of *generation,* the sole distinction (as I shall shortly attempt to point out to the reader), being this—namely, that in the former case we have an instance of the generation of *but a single individual structure;* in the latter, we have an example of *the simultaneous generation of several.*

"*This* process was essential to render the embryo of man a *living* embryo; *this* process it was which *constituted* that embryo a *living* being; and *then* this process was termed the process of *generation. This* process was further essential to render that embryo, become a fœtus, a *living* fœtus; *this* it was which *constituted* that fœtus a *living* being; and then it was termed the process of *growth.* And, finally, *this same process* was equally essential to render that fœtus, become a

man, a *living* man; *this same process* it was which *constituted* man a *living* being, and *then* it was termed the process of *nutrition*. Yes, in the *fully-developed man*, the *re*-generation of his component constituents is equally as essential to the continuance of man as a *living* being, is equally essential to the continuance of the phenomena of *organic* life; as in the simplest vegetation, in the embryo and in the fœtus, the *generation* of certain products was essential to constitute that vegetation, that embryo, or that fœtus a *living organism*.

"If, then, the process of the regeneration of his component constituents be essential to constitute man a *living* being, it is obvious that in order to be informed how the process of living is proceeding in man, we must learn how the process of regeneration is proceeding in his component constituents.

"That in the process termed '*nutrition*'—as it takes place in the component *simple* organisms or organizing atoms which are comprised in the *compound* organism man—we have nothing but the process *of generation* or *development* to investigate, and consequently no new physiological process to inquire into, I shall now endeavour to make apparent to my readers.

"In order that I may be clearly understood upon this topic, my readers will have the goodness to recall to their minds the supposed combination of three imaginary organizing atoms to which I directed attention in my chapter on Embryology, with the twofold purpose of illustrating what I meant by the expression *compound* organism, and of pointing out the nature of the relation which I conceive to subsist between the successive links of what I have termed the chain of progressively ascending organizing atoms—I allude to the imaginary compound organism which I supposed, for the purpose of illustration, to be formed by the union of three individual organizing atoms, selected respectively from the first three species of organizing atom in succession—namely,

one of what I termed the first, one of the second, and one of the third species of atom. We there saw that the specific function of the *first* species of atom in that compound (having regenerated a plurality of its own type) was to generate out of unorganized or mineral matter an organized residual product, which could stand in the relation of *specific stimulus* to the second species of atom in that compound; or, in other words, which could arouse or stimulate that second species of atom to the discharge of its specific function of *organizing*—in other words, of *conferring* (increased) *organization*. I shall now, in order to be as simple and as intelligible as possible, in place of the words *specific stimulus* (which, from the function it is destined by nature to fulfil, appears to me to be its appropriate appellation), I shall, I say, in place of the words *specific stimulus*, as applied to that residual product, substitute the word *nutriment*, which, as being more familiar, may, to some of my readers, perhaps, convey a more definite meaning. The function, then, of the *first* species of atom, in the imaginary compound organism to which I refer, was to generate (out of unorganized or mineral matter) an organized product, which could stand in the relation of what is termed *its nutriment* to the second species of atom in that compound. The function of the second species of atom in that imaginary compound was to generate (out of the organized residual product *or nutriment* prepared for it by the first) a second (or more highly organized) species of organized residual product, which could stand in the relation of what is termed *its nutriment* to the third and last species of atom in that compound. And, finally, the function of the third (and highest) species of atom in that imaginary compound was to generate (out of the organized residual product *or nutriment* prepared for it by the second) a third (or still more highly organized) species of organized residual product.

"But what is the design or object of this *third* species of

organized product? For the fulfilment of what end in nature has provision been made for *its* generation? What physiological function, in a word, has *this* organized residual product been designed to perform? The reader will be at no loss to recognize the importance of this inquiry. He will at once perceive that this *third* species of organized product is differently positioned as regards its physiological relations, from the products generated by the first and second species of atom in the above imaginary compound. He will, I say, observe that the organized residual product generated by the *third* species of organizing atom (namely, the *highest* species supposed to exist in the constitution of the organism under consideration) is in its physiological relations altogether differently circumstanced from the residual products generated by the other two species of atom in that compound. In the imaginary compound organism which I have selected for consideration, it is obvious that the residual product generated by the *third* species of atom cannot by possibility stand *in any relation* (either that of nutriment or other) to any atom of the *fourth* species *comprised in the constitution of the compound organism in which that product has been generated;* inasmuch as no atom of the fourth species exists in that compound, the *third* being the highest species supposed to enter into its constitution

Now, every organism in existence, whether simple or compound, must obviously, after the discharge of its physiological function, have at least *one* (and compound organisms, as we shall presently see, have frequently *several*)—every organism, I say, must have at least one residual product exactly similarly or analogously circumstanced. Every residual product similarly or analogously circumstanced affords an example of one of two things—namely, it is either the *highest species* of organized product contained within the organism in which it has been generated, as in the case we have just been considering; or else it is a residual product generated by an atom placed

at what I have termed *the top or summit of its branch* in the organizing chain; in a word, it is a product for which there does not exist *within the organism in which it has been generated* an organizing atom towards which it can stand in the relation of nutriment. That residual products so circumstanced *are* generated admits of no question; it consequently remains for us to determine what has been Nature's design in their generation; or, in other words, for the fulfilment of what function were they formed. There are but two ways in which to me it appears *to be possible* that nature could have designed that any so circumstanced residual product should be disposed of—that is, in *one or both* of the two following ways —namely, it must have been designed to stand in some relation (whether it be that of nutriment or other) to something *distinct and apart from the organism in which it has been generated;* or else it must have been designed to perform *some specific physiological function peculiar to itself* within the organism in which it has been generated. As an instance of the former, certain products may be generated *by* the vegetable *for* an animal creation; and as an example of the latter, nervous, muscular, vascular, glandular, &c. structures, are generated within the organism man. I trust, should there be any of my readers to whom I may not convey myself clearly, that they will understand me when I shall have illustrated the foregoing statements.

"Let us now, in place of the three imaginary atoms comprised in the composition of that imaginary compound organism, substitute the three *simple* organisms or organizing agents which generate respectively the three organized residual products known to us by the names *albumen, fibrin,* and *muscular fibre.* These three organisms I shall for perspicuity call the albuminous, the fibrinous, and the muscular atom. What is the specific physiological function respectively of each of these atoms? It is this—namely, the function of the *first* of

the three, or of the albuminous atom, is to generate (out of matter provided for that purpose by nature) that organized residual product which we call *albumen*, which albumen is designed by nature to stand in the relation of specific stimulus *or nutriment* to the second or fibrinous atom. The function of the *second* or fibrinous atom is to generate (out of the albuminous residual product or nutriment prepared for it by the albuminous atom) a *more highly* organized residual product named *fibrin*, which fibrin is designed by nature to stand in the relation of specific stimulus *or nutriment* to the third or muscular atom.* And, finally, the function of the *third* or muscular atom is to generate (out of the fibrinous residual product or nutriment prepared for it by the fibrinous atom) *a still more highly* organized residual product named *muscular fibre*, which muscular fibre being placed *at the top or summit of its branch* in the organizing chain, is designed by nature to fulfil *one or both* of the two following functions—namely, either to perform *some specific physiological function peculiar to itself* (viz., *contraction* in the case of muscular fibre) within the organism in which it has been generated; or else it is designed to stand in *some relation* (viz., in the case of muscular fibre, the relation of nutriment, for example, to carnivorous animals) to something distinct and apart from the organism in which it has been generated. For one or both of these functions, it appears to me that every organized residual pro-

* I have already observed, at page 95, that there is at present an uncertainty among physiologists as to the true relation in which *fibrin* stands to the more highly organized animal tissues. I have here retained the old opinion—namely, that it is the pabulum from which muscular fibre, &c., &c., are formed; but I have done so merely for the purpose of illustration. Whether it be *fibrin*, or be one of the constituents of the red corpuscule of the blood, or be something different from either, which goes to the formation of muscular fibre, &c., is immaterial to the present inquiry. *Something* obviously does so, and it is to that something I here refer.

duct, physiologically positioned similarly or analogously to muscular fibre, must of necessity have been destined.

"Such is an outline of the relation in which those three *simple* organisms stand towards each other; such is an outline of the functions those organisms are designed to fulfil. I would solicit my reader's serious attention to their contemplation. I would urge on him to make himself familiar with the operations of those three simple organizing agents, and he shall have acquired an insight into the nature of *all* the great physiological operations in nature. Yes, I say *all*, inasmuch as in the functions of those three granules, conjointly with those of the products which they generate, we have, as I regard it, presented us an example of each of the great physiological operations which take place throughout *the entire of organic creation*. We have, I say, as I regard it, therein disclosed to us an example of the *nature* of each of the successive steps in that *circle of changes* which is uninterruptedly in revolution from the mineral to the vegetable, from the vegetable to the animal, and from the animal again to the mineral world. That *circle* wherein we see—1st. The organizing of *unorganized matter* to take place in the *vegetable* kingdom. 2nd. The elevation of the *same matter* (thus organized) in the scale of organization to take place in the *animal* kingdom. 3rd. The appropriation of the *same matter* (thus elevated) to the requirements of the animal organisms *whereby* such organized matter is *of necessity reduced or degraded* in the scale of organization, and eventually again becomes *unorganized matter;* and finally, the *re*-organization of *the same* unorganized matter (thus reduced) again to pass through the same ascending succession of changes, and thus constituting a circle in perpetual rotation. In the functions of the three granules before us, together with the function of their products, we have, I say, an example of the *nature* of each of these changes. Let us, then, examine those functions

more closely,—let us trace *unorganized or mineral matter* from its departure from the unorganized or mineral world in its passage through the two departments of organic creation,—let us follow it step by step during its ascent in the scale of organization till *that same mineral matter* has eventually become *muscular fibre*,—let us see that muscular fibre on the discharge of its physiological function *depressed or degraded* in the scale of organization, and eventually reduced again to the condition of *unorganized or mineral matter*, and what shall we have done? We shall have done this: *We shall have passed in review the complete circle of the physiological phenomena which is in rotation throughout the entire of organic creation, the complete circle of changes which gives development to all existing organic phenomena, including the phenomena of* living, and, as I shall presently point out, of dying.

In selecting *muscular fibre* to illustrate the nature of what is termed "*the nutritive process*," as also of physiological operations in general, including the phenomena of *living* and *dying*,—in selecting muscular fibre, I say, for this purpose, I would say, "*ex uno dice omnes*," for the process is the same for *all* structures; and my readers may at will substitute for the words "*muscular fibre*" in the following observations, *cerebral matter, nervous structure*, &c., which are all *generated* or caused to *live*, and *degenerated* or caused to *die* in a manner in every respect identically analogous.

In an early part of this volume I directed the reader's attention to the fact, that an organizing agent of the humblest species, while in the act of conferring organization upon mineral matter, is itself at the same moment resigning or parting with the cause (be it what it may) of its own organization. It is yielding up to inorganic elements the organization itself had originally held, and in so doing is itself reduced to the condition of inorganic elements. In a word,

while that organizing agent is in the act of conferring organization and *life* upon inorganic *dead* matter, it is itself becoming inorganic or dead. This is an important consideration, to which I would solicit the reader's serious attention, as being in my opinion a question of the utmost moment to the science of physiology.

The fundamental inquiries in physiology ever must be into the nature of *life* and its relation to death. What is *life ?*—what is *death ?*—and how are these two states or conditions *related ?* These are the great questions which must at all times constitute the inquiries of greatest importance to physiological science. So far back as the year 1848, I ventured to submit my own opinion upon these momentous questions to the judgment of physiologists, expressing myself in the following words.

"Death! Wherein consists this solemn sounding term?

"Has death—man's final foe on earth—been made companion of his life? 'tis even so; nay, more, death is essentially a part of life. It is the transit of the organizing influence from the organizing atom which causes that atom's death. It is the transit of the same organizing influence to that atom's type which gives to that type its life. But it is *during*, and alone during such transit, that conjointly the two atoms live.

"Abandoned by the organizing influence, the elements of the old atom, now unfettered by opposing forces, become amenable to inert matter's laws—in a word, become inert; and this it is which constitutes its death. Controlled by the same organizing influence, the elements of the new atom assume the organized condition; in a word, become possessed of and adapted for imparting life; and this it is which constitutes it an organizing atom; this is what gives it life. But as it is while, and only *while*, the parent atom is resigning that influence which caused it to be an organizing agent, that such atom can be said to be dying; so it is while, and alone *while*,

the offspring atom is receiving the same organizing influence, that it can be said to be living; and thus are two essentially distinct and opposite processes, of necessity, concerned in producing the phenomena of active life; are, of necessity, in operation for the production of what we imply when we say of a thing, "it *lives*;" and thus, too, becomes apparent how death is essentially a part of life, how "in the midst of life we are in death."

"The result of these processes being the organization of matter which was hitherto unorganized, we would define living to be—the *act* of receiving the organizing influence—the *act* of being elevated in the scale of organization."*

The reader can now follow me in my attempt to trace mineral elements in their passage from the inorganic to the vegetable and from the vegetable to the animal world. He can understand, too, the changes—and their succession—which take place during that passage; and can comprehend what it is which constitutes "*nutrition*," and how it is that *death*—that is, *vegetative* or *organic* death—is related to *vegetative* or *organic* life.

"In the vegetable kingdom, inorganic or mineral matter has been raised (in a manner which I have already attempted to investigate) from its *unorganized* condition to that of the *simplest species of organized* matter; that is, to the condition of matter possessed of *the humblest or lowest degree of organization*. This elevation has been effected through the agency of the *simplest species* of organizing agent, which agent (or organizing atom) having generated from a portion of that organized matter a plurality of its own species, and having left another portion thereof as an organized residual product of the humblest or simplest species, is itself reduced to the condition of unorganized or mineral matter. The albuminous atom then discharges its specific function of organizing upon

* Freke on Organization, (1848) p. 48.

the organized residual product thus prepared for it by one or more humbler species of atom, radiates thereon its own influence centrifugally and in every direction, thereby surrounding itself with an envelope of this organized matter; raises that matter still higher in the scale of organization, and eventually disposes of it as follows—namely, 1st, regenerates a plurality of the albuminous atom (competent at any future period to discharge a similar function); and 2ndly, leaves an organized residual product to which has been given the name albumen, which is capable of standing in the relation of specific stimulus or nutriment to a higher species of organizing agent, as, for example, to the animal fibrinous atom. Such is the entire function of the albuminous atom, and, having discharged this function, it is itself reduced to the condition of inorganic or mineral matter.

"When the albumen *has entered* the animal vascular parietes, it there meets the fibrinous atom, to which it stands in the relation of specific stimulus (or nutriment); the consequence is that it at once arouses that atom to the discharge of its specific physiological function of organizing, or conferring organization (that is, of conferring upon that albumen an *increased* or higher degree of organization, or raising it in the scale of organization); converting that albumen, in a word, into a substance from out of which may be generated *animal tissues*. *Within* the animal vascular parietes, then, the fibrinous atom radiates its influence centrifugally, and in every direction, upon the albumen prepared for it by the albuminous atom. The result is, that this fibrinous atom in the first instance surrounds itself with an envelope of that albuminous product, thereby constituting a '*nucleated cell*;' then raises that albumen still higher in the scale of organization, and eventually disposes of it thus—namely, 1st, it regenerates a plurality of the fibrinous atom, which atoms (in the form of *microscopic granules*) it deposits in the circulating fluid to

constitute a portion of what is termed '*the liquor sanguinis of the blood;*' and 2ndly, it leaves an organized residual product to which we give the name *fibrin* (designed to stand in the relation of specific stimulus or nutriment to the muscular atom), which fibrin it also deposits in the circulating fluid, to constitute another component of the liquor sanguinis of the blood.

"Such is the *entire* function of the fibrinous atom, and, having completed that function, it is itself reduced to the condition of unorganized or mineral matter, which forms a third constituent of the liquor sanguinis of the blood.

"Have my readers ever examined the liquor sanguinis of the blood under the microscope? Doubtless the majority of them have. And what have they seen? I shall endeavour to inform them. They have seen minute granules *free*, that is, independent of an envelope, they have seen granules *partially enclosed* within a membraneous envelope; they have seen *completely enveloped* granules constituting "*nucleated cells;*" they have seen fragments or shreds of a membraneous nature; and, finally, they have seen saline and amorphous materials. They have seen, in a word, the fibrinous atom *before it had commenced the discharge of its function;* they have seen the same atom with its nutriment, *as that function was proceeding;* they have seen that atom (in the form of inorganic or saline materials) when its function had been completed; and, finally, they have seen *the results of the function of that atom.*. This (as it appears to me) is what they *must* have seen, for this, as I regard it, is what (for the most part) *constitutes* the liquor sanguinis of the blood.*

This liquor sanguinis, when required to fulfil the functions of "nutrition," becomes extravasated—by a process which it is unnecessary at present to inquire into—beyond the vascular parieties in the *extravascular interstices.* "Having arrived

* *Dublin Medical Press*, p. 420.

at the *external* surface of the vascular parieties, how *then* is the fibrin disposed of? It is thus. It *there* meets with the muscular atom (as also with the cerebral, nervous, glandular, &c., atoms), which it at once arouses or stimulates to the discharge of its specific physiological function of conferring (increased) organization. The muscular atom now presented with its specific stimulus or nutriment, radiates thereon its own influence centrifugally and in every direction, thereby surrounding itself with an envelope of fibrin—raises that fibrin still higher in the scale of organization; that is, converts it, though already highly organized, into matter possessed of a still higher degree of organization, which matter it eventually disposes of thus—namely, 1st, it regenerates a plurality of muscular atoms, which are competent, *when required,* to generate a new muscular fibre; and 2nd, it generates an organized residual product named *muscular fibre,* designed to perform the specific physiological function *(peculiar to itself)* to which we give the name *'muscular contraction.'* Such is the entire function of the muscular atom, and in the discharge of such function that atom has *itself* been reduced to the condition *of unorganized matter;* in a word, when its function has been completed, that atom has become a portion of the mineral world, has become *dead* or *inanimate* matter. The reader will please to observe that it is *an organizing agent* (viz., the muscular *atom*), and not *an organized residual product* (such as muscular *fibre*), which has during that process been reduced to the condition of unorganized or mineral matter.

"Such is the manner in which muscular fibre is *generated,* (mark the word *generated,* for we shall presently see the same muscular fibre *de*-generated, that is, undergoing the process of *disorganization* or *degeneration*), such, I say, is the manner in which muscular fibre is generated; and before proceeding further with the consideration of that fibre, I would venture to

solicit my readers to run over in imagination *the entire* of this process, from the organizing of unorganized or mineral matter to the conversion of that same mineral matter into muscular fibre. And why, I may be asked, *here* solicit thus of my readers? Simply for this reason, that *here* commences a new, and altogether distinct topic of inquiry; a new and altogether distinct class of organic phenomena—namely, the *de*-generation or *degradation* in the scale of organization of *an organized residual product* (mark, of *an organized residual product* in contradistinction to an *organizing agent*). Hitherto we have been contemplating the *generation* of organized residual products—namely, the *elevation* of such products by progressive steps, in the scale of organization. We now, *for the first time*, have to contemplate the *degeneration* of an organized residual product—namely, the *depression* or *degradation* of such products in the scale of organization, and consequently have to contemplate an altogether new and distinct class of phenomena.

"Hitherto we have been contemplating the process of generation or reproduction, but with the generation of muscular fibre and the like, we *have done* with that process. With the generation of that fibre, and of structures of its kind, we *have done* with what is termed "*the process of nutrition;*" we have done with the phenomena of organic or vegetative life; in a word, we have done with the *elevation* of matter in the scale of organization, and consequently we have done with the process of organic or vegetative "*living.*" *That* process (for the foregoing are all but one and the same physiological process under different names)—that process, I say, my readers have seen performed in a manner *identically the same* throughout the *vegetable* and the *animal* world. Of that process we now for the present take leave, to inquire what becomes of the *final* results of that process."*

* Freke in *Dublin Medical Press*, 21st January, 1852.

It is unnecessary for me at present to add more upon this second division of my subject—namely, upon developing organisms—further than to observe that the reader can now understand in what way the *plurality* of organizing atoms, originally developed by the embryonic germ—referred to in my former section—eventually become disposed of. It is thus. A portion thereof goes to the formation of the *new* embryonic germ; and a portion to carry on the process of development or "nutrition."

As I shall have to enter, however, somewhat more in detail upon this question in the next division of my subject, I need not now dwell on it, but shall pass from the consideration of developing organisms to the contemplation of organisms when the process of their development has been *fully completed*.

CHAPTER III.

DEVELOPED ORGANISMS.

VIZ: ORGANISMS, THE PROCESS OF WHOSE DEVELOPMENT HAS BEEN COMPLETED—NAMELY, FULLY DEVELOPED ANIMALS.

IN our last chapter we were contemplating the process of development while that process was in actual progress—while, in a word, it was in the act of giving development and formation to the individuals which constitute the different species of animals and plants. We were contemplating, in other words, that process which in popular language has received the various appellations, generation, nutrition, growth, assimilation, development, &c. I say this process of development has received the several foregoing names; for all these so called different processes are in reality but one and the same physiological process, occurring under different circumstances, and which have been designated by different names. They are all nothing more or less than the process of *generation* or *development;* and all, however differently named, comprise within them simply the development of an organized residual product, and the redevelopment of a plurality of the germs of that product.

We have now reached the termination of that process. With the development of muscular fibre, nervous tissue, cerebral matter, &c.—namely, what I have designated the *final* results of the nutritive process—with the development, I say, of such final results we have done with that process, inasmuch as we have reached the termination of development; in a word, when those tissues have been fully developed, the process of development has been completed.

The question here at once suggests itself—what has been

the *design* of this process? For what object has it been established? For what end have these tissues we have been contemplating been developed? What object has nature had in view in thus pushing matter progressively forward from the mineral world through the vegetable kingdom and thence to the summit of the animal scale, and then stopping short at this point? In a word, what great end has been designed by nature by the phenomena of *vegetative* or *organic life?*

The answer to that question is simple, it is this—namely, the ultimate end to be accomplished by the process of development was the formation of structures adapted for giving manifestation to a totally *new class* of vital phenomena; namely, to a class of phenomena altogether distinct from the phenomena of vegetative or organic life. The object with which *vegetative* or *organic* life has been established was, that through its agency or means development might be given to a class of organized structures adapted for giving manifestation to the phenomena of *animal* life.

I would here say a word upon the *nature* of this latter class of phenomena—namely, the phenomena of *animal* life—in contradistinction to the phenomena we have hitherto been contemplating, namely, the phenomena of *vegetative* or *organic* life.

There is a marked distinction between the nature of the *results* which accrue from the development of the phenomena of *animal* and of *vegetative* or *organic* life, which it is necessary the reader should bear in mind. The distinction I refer to is this. We have already contemplated the phenomena of vegetative or organic life, and have seen that the development of such phenomena is inseparably associated with the formation of some *material* or *substantive* product, such as albumen, lignin, muscular fibre, nervous tissue, cerebral matter, &c. I say some *material* or *substantive* product. Now such is *not* the case with regard to the development of the phenomena

of *animal* life, but such development is accompanied with results of a totally and altogether different nature. The development of the phenomena of *animal* life is in no way associated with the formation of *any material* or *substantive* product whatever, but solely with phenomena of an altogether *immaterial* or *non-substantive* nature—such as mental phenomena, nervous phenomena, and the phenomena of muscular motion. The development of these latter (viz., animal) phenomena so far from being associated—like the phenomena of *organic* life—with the *elevation* of matter in the scale of organization, we shall presently see to be inseparably dependent upon the very opposite process; namely, upon the degradation or descent in the scale of organization of those very organized tissues which we have just seen *organic* life developing or constructing. Animal life, in a word, pulls down the very structures that vegetative or organic life has been employed in building up.

Having said thus much upon the distinction that is to be observed in the *nature* of the results developed by *organic* and by *animal* life—namely, that the former are *material products*, and the latter *immaterial phenomena*—we may now contemplate the phenomena of *animal* life somewhat more in detail.

We have traced the phenomena of vegetative or organic life from their commencement to their termination. We have followed mineral matter step by step from the inorganic world till it had become muscular fibre. I shall now trace it a step further and see what ultimately becomes of those mineral elements, or how, in other words, that muscular fibre becomes ultimately disposed of. Upon this subject I have thus expressed myself in 1852:—

"*Here*, then—that is, when the generation of muscular fibre, &c., has been completed—*here*, I say, commences, with the *function* of that muscular fibre, a new and altogether dis-

tinct class of organic phenomena, giving development to a new and altogether distinct class of results—namely, to those results termed 'the phenomena of *animal* life.' Let us, then, contemplate the development of such phenomena, and observe *how that development effects the constitution of muscular fibre, &c.* The general organism (man) has a demand for the operation of the specific physiological function of muscular fibre; that is, in other words, has occasion for muscular motion, which muscular motion is a phenomenon peculiar to *animal* life. But the discharge of this function (namely, muscular motion) *of necessity de*-generates, or, in other words, *degrades* in the scale of organization that muscular fibre, so as altogether to incapacitate it from again performing a similar function. If, then, the general organism (man) has a *second time* a demand for the operation of muscular fibre, what must be the result? The result must be obviously this—namely, that one of the *offspring* atoms, which we have recently seen generated, must be called to the discharge of its physiological function. An offspring atom, I say, must be called on, *again* to raise matter in the scale of organization, *again* to confer increased organization on fibrin. In a word, must be called on *to generate a new muscular fibre.* Hence the necessity for the renewal of the regenerative process; hence the necessity for the *repetition* of what is termed *the process of nutrition.*

"Let us now reflect for a moment upon the two processes we have just been contemplating—namely, that of the *generation* and of the *de*-generation of muscular fibre. We have attempted to trace unorganized or mineral matter from the inanimate world in its passage through the two departments of organic creation; we have seen that by successive acts *of generation* that matter has eventually been converted into muscular fibre; we have seen that, during its passage through the vegetable and the animal kingdom, such matter has been converted into

different species of *organized residual products,* such as those we call albumen and fibrin ; and we have seen that each succeeding residual product had conferred upon it a *higher degree* of organization than the preceding residual product had possessed. But mark this well, *in no instance* during the passage of that matter through the vegetable and the animal kingdom have we seen the *de*-generation of *an organized residual product.* In no instance, I say, during the process of generation or 'nutrition' have we seen *an organized residual product* depressed or degraded in the scale of organization. It is not till the process of generation or 'nutrition' had been *completed* that the *de*-generation of *an organized residual product* commenced; it was not till the *final* results of 'nutrition' had been formed that *an organized residual product* began to *descend in the scale of organization.* In a word, it was not till an organized residual product was called on to develope 'the phenomena of *animal* life,' that the disorganization or degeneration of *an organized residual product* commenced. And what do we collect from this fact? We collect this, as it appears to me, all important result—namely, we arrive, as I regard it, at the true nature of *the distinction between a vegetable and an animal.* And what is that distinction? It is, as I regard it, this—namely, in the *animal* the *de*-generation of *an organized residual product* takes place ; in the vegetable *no such* de-generation occurs. The function of the vegetable is *single*—namely, the *generation* of organized structures ; the function of the animal is twofold—namely, 1st, the *generation* of organized structures; and 2nd, the *de*-generation of those structures to give development to 'the phenomena of *animal* life.' The vegetable world has been formed to *generate* a variety of *organized residual products,* the generation of which is of necessity accompanied with the *de*-generation or disorganization of *the organizing agents* through whose instrumentality or agency such

generation was effected, but the generation of which is *never* accompanied with the *de*-generation of *an organized residual product.* The animal world has, in like manner, been formed to generate a variety of organized residual products, the generation of which is, in like manner, inseparably associated with the *de*-generation or disorganization of each of those *organizing agents,* through whose agency or instrumentality such generation was accomplished or brought about; and in it, too, in like manner as in the vegetable world, the generation of such products is *never* associated with the *de*-generation or disorganization of *an organized residual product.* But the animal has an *additional* end to accomplish in nature; has *another* and all-important function to fulfil. It has to develope 'the phenomena of *animal* life.' The development of *such* phenomena (and of such phenomena *exclusively and alone*) is inseparably associated with the *de*-generation or disorganization of *organized residual products*—namely, of the *final* results of '*the nutritive process.*'"*

The reader who has gone with me thus far, is now in a position clearly to understand what I conceive to be the *relation* which subsists between *life* and *death.* He can now fully comprehend what I mean, when I state that *all* vital phenomena *universally*—namely, *animal* as well as *organic*—are indispensably *dependent* upon the disintegration or degradation in the scale of organization—and, consequently, ultimately upon the *death*—of those organic entities or structures whose functions are to give development to such vital phenomena. I say *all* vital phenomena *universally,* for such statement is equally applicable to the development of the phenomena of *organic* and of *animal* life. I shall now for perspicuity recapitulate the foregoing statements in relation to the *dependency* of life upon death; and that in reference both

* Freke in *Dublin Medical Press,* 21st January, 1852.

to *vegetative* or *organic*, and to *animal* life, and death. I shall then throw the whole subject again into a tabular form, and, having done so, shall take leave of the question of "*the origin of species.*"

In my publication of 1852, I have expressed myself thus upon this question :—

"Organic or living creation has so been arranged or constructed by nature that *the act* of giving development or manifestation to what are termed "*vital phenomena,*" in general, has been inseparably associated with, and made indispensably dependent upon, *the depression or degradation of matter in the scale of organization.* In a word, the phenomena of *life* have been made *indispensably dependent* upon the phenomena of *death.*

"It is in accordance with this general arrangement or provision of nature that every organized structure, occupying a physiological position in the *animal* kingdom analogous to that of muscular fibre, must, *while in the act of* discharging its specific physiological function, be at the same time undergoing the process of disorganization or degradation; must at the same time be *in the act* of losing or parting with that condition which constituted it an *organized structure.* Paradoxical, then, as such statement may appear to those who may never have reflected on the subject, at the moment that an organized structure is giving development to what are termed the "phenomena of *animal* life," at such moment that structure is *descending* in the scale of organization; is resigning or parting with its organic or physiological properties; is approaching the condition of dead or inanimate matter; in a word, is undergoing the process of dying. If, then, during the period of the development of the phenomena of animal life—namely, of mental phenomena, nervous phenomena, and the phenomena of muscular motion—if, I say, *during the period of their development,* the organized structures, which are the

source or origin of such phenomena, be themselves at that moment approaching the condition of dead or inanimate matter; be resigning or parting with their organic or physiological properties; and consequently, be thereby becoming *utterly incapacitated* from *again* giving development to the phenomena in question; if, I say, such be the case (and that such is the case admits of no question), it is obvious that, should it be required, that mental phenomena, nervous phenomena, or the phenomena of muscular motion should be *continuously* developed in man; it is, I say, obvious that, in order to accomplish that end, the organized structures which develope or give manifestation to such phenomena (that is, cerebral matter, nervous tissue, and muscular fibre) must themselves be undergoing the process of *continual renewal*. Hence we can understand *why it is* that, in order to continue to be a living being, man must *continuously* be furnished with food."*

The reader can here perceive how the *plurality* of embryonic germs developed at each act of generation, and referred to on a former occasion, ultimately become disposed of according as the development of vital phenomena is proceeding. One portion of that plurality becomes deposited, as I have observed, in the ovary, to contribute to the formation of the embryonic representative of the individual; and another portion of that plurality is employed, first, in the *development* of the individual (which is *all* that takes place in the *vegetable*), and, secondly, in the re-generation of the animal tissues which have been degraded during the development of the phenomena of *animal* life, such as mental phenomena, nervous phenomena, and the phenomena of muscular motion. With this remark I shall resume my quotations from my publication of 1852.

"I shall now proceed to attempt to point out somewhat more clearly to the reader, what I conceive to be *the nature* of the connexion that exists between *life* and *death*, and shall

* Freke in *Dublin Medical Press*, 21st January, 1852.

endeavour to convince him that the phenomena of living *in general* (including those of vegetable and animal life) *have been* made indispensably *dependent* upon the phenomena of organic degeneration or *dying.*

"There are *but four circumstances or conditions* under which it is possible to contemplate matter in its relation to what we term organization and life; that is, in other words, matter in its relation to what is termed organization and life, must be contemplated while in one of the four following conditions—namely, such matter may be contemplated, 1st, in its unorganized or mineral condition, that is, totally and altogether devoid of organization or life; in a word, it may be contemplated as *dead or inanimate matter.* 2nd, such matter may be contemplated while in the act of receiving organization and life; that is, while in the act of passing either from the condition of dead or inanimate matter to the condition which constitutes it organized, or from the condition of organized matter to the condition of matter possessed of a higher degree of organization; in a word, it may be contemplated while *in the act of being elevated in the scale of organization.* To matter so circumstanced, I have for perspicuity ventured to restrict the term *'living'*—that is, *vegetative* or *organic* living—in order to enable me more clearly to point out to the reader the nature of the *dependency* of *life* upon *death.* 3rd, such matter may be contemplated when possessed of organization and life, but existing in a quiescent or inactive condition; that is, while manifesting no active phenomena which distinguish it from dead or inanimate matter; as, for example, in the condition of the seed of a vegetable before germination has commenced; matter so circumstanced, I would for 'perspicuity' term, *matter possessed of quiescent vitality.* And, 4th and lastly, such matter may be contemplated while in the act of resigning or parting with organization and life; that is, while in the act of descending either from the condition of organized

to that of inorganic or mineral matter, or from the condition of matter possessed of a higher, to that of matter possessed of a lower degree of organization; in a word, it may be contemplated while *in the act of being degraded in the scale of organization.* To matter so circumstanced I would, for perspicuity, venture to apply the term *dying,* in order to enable me to point out more clearly to the reader, the nature of the *dependency* of *life* upon *death.*

"Hitherto our investigations have been chiefly confined to the contemplation of matter while in the *second* of the foregoing conditions. That is, we have been chiefly engaged in considering the effects produced *upon dead or unorganized* matter by the *imparting or communication* thereto of some vitalizing or organizing cause; we have been contemplating, in a word, the cause of the *life* of such matter. In relation thereto we have followed such matter (that is, matter which had *originally* been dead or inanimate) while in the act of passing from the unorganized to the vegetable world; while in the act of ascending in the vegetable kingdom; while in the act of passing from the vegetable to the animal world; and, finally, while in the act of ascending in the animal kingdom. During the period that each of these transitions (which were effected by *the process of generation,* and constituted what is termed '*the process of nutrition*')—during the period, I say, that each of these transitions was in progress, we saw development given to what we understand by the phenomena of *living;* that is, to the phenomena of *vegetative* or *organic* living. But such is not the *sole* aspect under which organic phenomena should be contemplated; they should be reviewed in another, an opposite, and a no less important relation. We should contemplate the effects produced upon *vitalized or organized* matter by the *withdrawal* or *resignation* of the vitalizing or organizing cause; we should contemplate, in a word, the cause of the *death* of such matter.

"I have already directed my readers' attention to the fact, that is was during, and alone during, the period that the simplest conceivable vegetation, and what I have termed its specific stimulus (viz., nutriment)—namely, inanimate or mineral matter—were reciprocally acting upon each other, that those two entities *conjointly* constituted what we understand by a *living* being. We were *then* chiefly contemplating the process of *living* in that vegetation; I am now desirous of contemplating in the *same* vegetation the opposite process, or the *process of dying*. For, upon a closer analysis of what was taking place during the reciprocal action of those two entities upon each other, we shall find that what *one* was *obtaining* the *other* was *losing;* we shall find that, at the same time that the process of the elevation of dead or inanimate matter to the organized condition was in operation, another and directly opposite process was also in progress; namely, the simple vegetation which was conferring that organization was itself undergoing the process of disorganization or degeneration, was itself *descending* in the scale of organization. When its function was finished, that vegetation was reduced to the condition of inanimate matter. In a word, when its function was finished that vegetation was *dead*. Let us now rapidly again trace unorganized or mineral matter from the dead or inanimate world in its passage through the vegetable and animal kingdoms; let us again watch the succession of changes which takes place in that matter till it has eventually become muscular fibre; let us do so—*not* for the purpose of again contemplating the process of *living* in that matter—but for the purpose of ascertaining *how that process* is *dependent* upon the process of *dying*. The following is that succession of changes—namely, *while* the simplest organizing agent was in the act of conferring organization upon inorganic or mineral matter, and generating therefrom its own type and an organized residual product, the process of *living* was in operation,

for inanimate matter was in the act of being elevated in the scale of organization; but the organizing agent which was conferring that organization was, itself, resigning or parting with its organized condition, was *itself* descending in the scale of organization. In a word, that *organizing agent* was undergoing the *process of dying*. When its function was completed, that *agent* was dead, was reduced to the condition of mineral matter. *While* the albuminous atom was in the act of conferring (increased) organization upon the matter prepared for it by an humbler atom, and generating therefrom its own type and an organized residual product, the process of *living* was in operation; for that *organized residual product* was in the act of being elevated in the scale of organization; but the *organizing agent*—namely, the albuminous atom, which was in the act of conferring or imparting that organization, was, *itself*, during that period in the act of resigning or parting with its organized condition; was in the act of *descending* in the scale of organization. In a word, that *organizing agent* was undergoing the process of *dying*. Thus, then, we have traced inanimate or mineral matter to its conversion into vegetable albumen; that is, we have traced such matter till it has become prepared to leave the vegetable and enter the animal kingdom. And what have we learned as *regards death* during that passage? We have learned these two (as I regard them) most important physiological facts; namely, 1st, that each *succeeding step* in the ascent of that matter, during its passage through the vegetable world, is *indispensably dependent* upon the disorganization and ultimate *death* of the *organizing agent* which was the cause of that ascent; and 2nd, that during that ascent no *organized residual product* has undergone the process of disorganization and ultimate *death*, but, on the contrary, that at each succeeding step in that ascent the organization of such organized residual product has been augmented. Let us follow that albumen in its pas-

sage through the animal world, and we shall find the same results to obtain, *till the final or ultimate products of generation (*or *'nutrition') have been formed. While* the fibrinous atom was in the act of conferring increased organization upon albumen, and generating therefrom its own type and an organized residual product, the process of living was in operation, for albumen was in the act of being elevated in the scale of organization, or, in other words, fibrin was in the act of being generated ; but the *organizing agent* (namely, the fibrinous atom) which was in the act of conferring or imparting that organization was, *itself*, during that period, in the act of resigning or parting with its own organized condition ; was in the act of *descending* in the scale of organization. In a word, that *organizing agent* was undergoing the process of *dying.* So, too, during the generation of muscular fibre. *While* the muscular atom was in the act of conferring increased organization upon fibrin, and generating therefrom its own type and muscular fibre, the process of living was in operation ; for fibrin was in the act of being elevated in the scale of organization, or, in other words, muscular fibre was in the act of being generated ; but the *organizing agent* (namely, the muscular atom) which was in the act of conferring or imparting that organization was, *itself*, during that period, in the act of resigning or parting with its own organized condition ; was in the act of *descending* in the scale of organization. In a word, that *organizing agent* was undergoing *the process of dying.*

"We have now reached the *final results* of the process of *generation,* or of what is popularly termed *'the nutritive process.'* With the generation of those results we have done with the process of generation, or, in other words, we have done with the phenomena of *organic* life. And what have we learned from the contemplation of those phenomena ? We have learned these two (as I regard them) important physio-

logical facts—namely, 1st, that the phenomena of organic life *consists in* the generation of *organized residual products* (as also the regeneration of organizing agents whereby similar products may be regenerated); and 2nd, that the generation of those products is *dependent* upon the *death* or disorganization of the *organizing agents* through whose instrumentality those products were generated.

"The function of muscular fibre, &c. has now to commence; in other words, now commence the phenomena of *animal* life. And how are those phenomena developed? It is—and let the reader impress this fact upon his mind—it is *by the disorganization* or degeneration of an *organized residual product.* Mark this well; we *no longer* have the disorganization of an *organizing agent,* but now (with the development of the phenomena of *animal* life) we, *for the first time,* have the disorganization of an *organized residual product.* We have the *de*generation or *dying* of the *final results* of the regenerative process. What, then, do we collect *in relation to death,* from the contemplation of the phenomena of *animal* life? We collect these two (as I regard them) important results—namely, 1st, that the development of the phenomena of *animal* life is *dependent* upon the *death* or disorganization of an *organized residual product;* and 2nd, that with the development of the phenomena of *animal* life commences, *for the first time,* the disorganization or *dying* of an *organized residual product.* Thus, then, the phenomena of *organic* life (that is, in other words, the phenomena of *generation*), which are common alike to the vegetable and to the animal, are *dependent* upon the *death* of an *organizing agent;* whereas the phenomena of *animal* life, which are peculiar exclusively to the animal, are *dependent* upon the *death* of an *organized residual product.*

"If, now, for perspicuity, and for the purpose of concisely summing up the foregoing remarks, I might venture for a

moment to term the death of an *organizing agent (or atom) atomic* death; and the death of an *organized residual product* (in contradistinction thereto) *residual or productral* death. The distinction between the vegetable and the animal might be thus briefly expressed—namely, in the vegetable world there is *organic* life, *dependent* upon *atomic* death; and such is *all* that takes place in the *vegetable* world: in the animal word there is *organic* life, *dependent* upon *atomic* death; and, in addition thereto, there is *animal* life *dependent* upon *residual* or *productral* death.

"There is, at first sight, an apparent paradox in stating that a structure is *dying* while in the act of giving manifestation to *vital* phenomena, which arises from the *inseparable association* of the phenomena of *death* with those of *life*, and which, from the nature of that association, it would be difficult to avoid. It requires, however, but little reflection to perceive that this paradox is more apparent than real; and, after a most careful and mature consideration of the entire of the subject, no terms have suggested themselves to my mind which, I considered, would enable me to lay more clearly before my readers what I regard to be *the nature of the dependency of life upon death.**

The reader may possibly remember that, when attempting to establish the *atomic* constitution of a simple organizing agent, I expressed it as my opinion that such simple organizing agent did not admit of *chemical* transformation, without a destruction of that integrity, which, in my opinion, is essential to constitute it a physiological integral or unity. He may further remember my adding these words, "except under peculiar circumstances, to be hereafter then referred to"—(page 23.) The peculiar circumstances then alluded to are those we have just now been contemplating—namely, the circum-

* Freke in *Dublin Medical Press*, 21st January, 1851

stance of such simple organizing agent discharging its physiological function of conferring or imparting organization. Here, no doubt, we *do see* the elementary constituents of that simple organizing agent undergoing the process of *chemical* transformation. But what is the result? The result is *eventually* this—namely, the total *disorganization* and destruction of that organizing agent, as such,—the complete and perfect annihilation of its existence as an organic or physiological integral or unity: in a word—its reduction to the condition of dead or inanimate matter; and that, too, as the result of the discharge of its special physiological function. This, then, I would venture to offer as another argument in addition to those I have already submitted in support of the *atomic*—that is, *physiologically* atomic—constitution of organizing agents.

I shall now again, for the sake of perspicuity, throw the foregoing observations into the form of a chart, so as to enable the reader at once to recall, at a glance, the leading points I have been attempting to establish. The chart alluded to will be found opposite the title page.

I shall point with an index finger the *direction* in which organization is progressively advancing, and in doing so shall trace *mineral elements* from the inorganic world to the humblest species of organized matter, watch them as they are ascending in the vegetable kingdom, and from thence follow them in their progressive elevation to the cerebral matter, &c. of man. I shall then with the same index, trace those elements in their return to the mineral or inorganic world, again to undergo a similar succession of changes. The reader will herein recognize the circle in perpetual rotation, formed by those elementary components to which I have already directed his attention.

The chart referred to, is, I trust, sufficiently clear when viewed in connexion with the foregoing observations—to explain its own meaning, without any additional observation upon my part, and I shall consequently leave it to elucidate itself.

I have now endeavoured to trace the various different species of organized beings, from their *origin* to their *perfect development*. With this, the task I have imposed upon myself is at an end.

The *classification* of such different species has no relation to the point I have undertaken to attempt to establish, which is exclusively the *origin* of those species by means of what I have termed *organic affinity*.

CONCLUSION.

In taking leave of the question of "*the origin of species*," I cannot refrain from expressing my deep and unfeigned regret at a course of proceeding which I believe to be most prejudicial to the progress alike of religion and science. I allude to a growing tendency, which may be recognized in many pious and well-intentioned men—men deservedly respected for their high character and moral worth—to designate by such terms as "*materialist*," "*infidel*," "*unbeliever*," and the like, all who, in their researches upon any question of science, may have reached results which do not harmonize with *their* interpretation of Scripture. I recognize this spreading tendency with a feeling of extreme pain, because I believe it to be fraught with consequences not only prejudicial to science, but also most injurious to that cause which they are themselves most desirous to serve. I acknowledge that the *motive* by which they are actuated is the *best*, but while approving that motive, I cannot resist the conviction that they are guilty of a serious error in judgment.

The works of the Creator's hand *cannot* be contradictory of His uttered words, but interpretations of *both* works and words may be and *have been* erroneous. If, then, *unequivo-*

cally established truths in science be found to be at variance with hitherto generally received *interpretations* of Scripture, the result that is inevitable is obvious; namely, the *received interpretations*, having of necessity been erroneous, *must*, at once and unhesitatingly, be abandoned. That *unequivocally established* truths in science *have* contradicted and overthrown generally received erroneous interpretations of Scripture, is a statement which no one will question; and the truth of this statement ought, I think, to suggest caution in adopting that line of proceeding against which I am now expressing disapprobation.

I say, I believe such course of proceeding to be prejudicial to the progress both of religion and science. Of religion, and for this reason: When the justly respected defenders of religion pronounce a scientific announcement to be in opposition to the written word of God, the supporters of religion may at once repudiate such scientific announcement as false. But should that announcement eventually become established as an unquestionable scientific truth, then the result is that the *opponents* of religion conceive they have a triumph, while many of its supporters may become shaken in the confidence they had hitherto placed in its defenders, and may also become doubtful of its truths. These are results which, unhappily for religion, have already but too frequently occurred —these are results which the champions of religion—among the number of whom I should desire my own name, however humble, to be enrolled—should most strenuously endeavour to resist.

I say, I believe such course to be prejudicial to the progress of science as well as of religion; and I say so in the first place, because I entertain but little doubt that, even at the present day, many seriously minded and reflecting men are deterred from giving expression to thoughts, it may be, of great moment to science, from the mere apprehension of the

consequences to which I have referred. But, even independently of this, I would ask—had *the adopted* interpretations of Scripture been at *all times* the barrier beyond which research should not dare to extend, what would be the condition of science to-day? Where would be the discoveries of Newton? Where those of modern geologists? In a word, what light should we now have upon *any* branch of physical science? Literally, almost none!

Who is there, at all familiar with the history of science, who is not aware that, even up to so late a period as the sixteenth century, the universally entertained opinion was that the sun moved round the earth; and that to maintain the contrary was regarded as direct hostility to the clearly expressed word of God?

"Until the time of Copernicus," observes the Rev. Dr. Hitchcock in his work on Geology, "no opinion respecting natural phenomena was thought more firmly established, than that the earth is fixed immoveably in the centre of the universe, and that the heavenly bodies move diurnally around it. To sustain this view, the most decided language of Scripture could be quoted. God is there said to have *established the foundations of the earth, so that they could not be removed for ever;* and the sacred writers expressly declare that the sun and other heavenly bodies *arise and set,* and nowhere allude to any proper motion in the earth. And those statements corresponded exactly to the testimony of the senses. Men felt the earth to be immoveably firm under their feet, and when they looked up, they saw the heavenly bodies in motion. What bold impiety, therefore, did it seem, even to men of liberal and and enlightened minds, for any one to rise up and assert that all this testimony of the Bible and of the senses was to be set aside! It is easy to conceive with what strong jealousy the friends of the Bible would look upon the new science, which was thus arraying itself in bold defiance

of inspiration, and how its votaries would be branded as infidels in disguise. We need not resort to Papal intolerance to explain how it was that the new doctrine of the earth's motion should be denounced as the most fatal heresy, as alike contrary to Scripture and sound philosophy, and that even the venerable Galileo should be forced to recant it upon his knees. What though the astronomer stood ready with his diagrams and formulas to demonstrate the motion of the earth, who would calmly and impartially examine the claims of a scientific discovery, which by its very announcement threw discredit upon the Bible and the senses, and contradicted the unanimous opinion of the wise and good of all mankind, —indeed, through all past centuries? Rather would the distinguished theologians of the day set their ingenuity at work to frame an argument in opposition to the dangerous neology, that should fall upon it like an avalanche, and grind it to powder. And to shew you how firm and irresistible such an argument would seem, we need no longer tax the imagination; for Francis Turretin, a distinguished Protestant professor of theology, whose writings have even to the present day sustained no mean reputation, has left us an argument on the subject, compacted and arranged according to the nicest rules of logic, and which he supposed would stand unrefuted as long as the authority of the Bible should be regarded among men. He propounds the inquiry, 'Do the sun and moon move in the heavens and revolve round the earth, while the earth remains at rest?' This he affirms, 'in opposition to certain philosophers,' and sustains his position by the following arguments: First. The sun is said in scripture to move in the heavens, and to rise and set. The sun is *as a bridegroom coming out of his chamber, and rejoiceth as a strong man to run a race. The sun knoweth his going down. The sun also riseth, and the sun goeth down.* Secondly. The sun, by a miracle, stood still in the time of Joshua. And, by a miracle,

it went back in the time of Hezekiah. Thirdly. The earth is said to be *fixed immoveably. The world also is established, that it cannot be moved. Who laid the foundations of the earth, that it should not be removed for ever. Thou hast established the earth, and it abideth? They continue this day according to thine ordinances.* Fourthly. Neither could birds, which often fly off through an hour's circuit, be able to return to their nests; for in the mean time the earth would move four hundred and fifty of our miles. Fifthly. Whatever flies or is suspended in the air ought [by this theory] to move from west to east; but this is proved not to be true, from birds, arrows shot forth, atoms made manifest in the sun, and down floating in the atmosphere.'"

It is needless for me to add more on this topic, but the foregoing reflections are, in my mind, of too serious a nature to admit of being lightly regarded.

In making these observations, however, I desire that it should be distinctly understood that I do so with no reference whatever to the opinions I have been advocating in the foregoing pages. Those opinions I am prepared to show are in no way open to the course to which I object. I have stated in my preface, that "nothing has been advanced in this publication which is not perfectly in harmony with the Mosaic record of Creation;" and I am fully prepared to substantiate that statement. God forbid that I should dare to contemplate—far less insanely attempt to establish—any result at variance with the *true* interpretation of His Word; but it must be obvious to every reflecting man who will but reflect on the question, that there *must* have been a period in the first man's *material* existence, antecedent to that in which we are told that God "breathed into his nostrils the breath of life, and man became a living soul." It is that *antecedent period* that I have been contemplating.

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